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ACTA GEOGRAPHICA 1, N:o 1

THE
UPPER YENISSEI DRAINAGE AREA

(TERRITORY OF URIANKHAI)

EDITED BY

H. HAUSEN

GENERALITIES. — GEOLOGICAL OBSERVATIONS MADE DURING AN EXPEDITION IN 1917 BY *J. J. SEDERHOLM* (Chief of the Expedition), *H. G. BACKLUND* (practical leader), *ST. FOSLIE*, *TH. BRENNER* AND *THE EDITOR*. — FURTHER OBSERVATIONS DURING 1918 BY *THE EDITOR*. — BIBLIOGRAPHY. — ITINERARY MAPS MADE BY *ST. FOSLIE* AND *H. G. BACKLUND* PARTLY IN COMPANY WITH *THE EDITOR*.

HELSINGFORS 1925

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A.-B. F. TILGMANNS TRYCKERI

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I. Preface.

The present work is chiefly a compilation of field observations made by a number of geologists engaged in prospecting expeditions to the Uriankhai country on the frontier of Siberia and Mongolia, which were organized on the initiative of Prof. J. J. SEDERHOLM of Helsingfors (Finland). The first expedition started from Finland in the beginning of the summer of 1917 and its members were the following geologists: J. J. SEDERHOLM (Chief), H. G. BACKLUND (practical leader), ST. FOSLIE, TH. BRENNER and the Editor. The principal area to be surveyed was the upper part of the Huakhem drainage basin, one of the head arms of the Yenissei river. Here considerable distances were covered by the said geologists, except the writer, who travelled in the middle sector of Tangnu-Ūla, later in company with MR. H. BACKLUND. During all these journeys itinerary maps were made up and also numerous rock specimens were collected. Regarding the practical purpose of the Expedition, it may be understood, that the theoretical results do not stand in full relation to the survey apparatus. The roughness of the country, the general difficulties of war and revolution, and finally the short time, which was left at the disposal of the Expedition, were also obstacles to take into consideration when valuing the results. — The material collected was transported to Finland (Academy of Åbo) except the largest rock collection belonging to MR BACKLUND, which was left behind in St Petersburg and could not later be brought home in consequence of political difficulties.

At the beginning of the following year, 1918, the writer started another expedition to the same country, now in company only with MR E. STRANDSTRÖM, which was engaged for several practical purposes. This time the political situation was still worse but the Expedition arrived safely at Uriankhai. The field work was now directed mainly to the middle sector of Tangnu-Ūla. The course of the Yenissei river between Bielotzarsk and Dshakul was also examined geologically. The field work was stopped, however, already in the midst of the working season, because of the outbreak of the civil wars in Siberia. Now it was impossible to make any surveys until the late autumn of 1919, when the writer started for a journey from Irkutsk to the East Sayan Mountains and the region of the upper Selenga river in Mongolia. This time the writer was again obliged to stop his work very soon, in consequence of the great political events occurring at the beginning of the year 1920.

The writer returned to Finland at the end of the year 1920.

To meet transport difficulties it was necessary to reduce the rock collections made but the most typical specimens and also the field journal were safely brought home to Finland.

All the material[1] was then utilized and compiled in the Geological Institute of the Academy of Åbo. The Leader of this Institute, Prof. H. Backlund, partly assisted by Mr. H. Kranck, undertook the microscopical examination of most of the specimens, while the writer collated all the field observations and also constructed a geological sketch map of the country. The results of the microscopical work and the systematic geological deductions will, however, be published later. Only general remarks and the itinerary observations are communicated here, accompanied by the corresponding route maps and a large number of photographic views.

Finally the writer wishes to express his hearty thanks to his fellow workers of the Expedition (1917) for their courtesy in placing at his disposal all material collected. He is especially indebted to Prof. H. Backlund for his active interest and assistance in the compilation of the present work.

The Editor.

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[1] The collections consist of 740 rock specimens, 476 of them being thin sections.

II. Physiography of the Area.

By H. Hausen.

Orography, Hydrography, Climatology, Phytogeography, Population and Communications.

Limitation of the Area.

»The upper Yenissei drainage area» as understood in this paper, comprises the Mongolian boundary territory of Uriankhai[1] and the Uss-country, lying immediately north of the former and occupying the middle part of the West-Sayan Mountains; and also the south of the Yenissei Government, partly occupied by the West-Sayans and partly by the steppe, and drained by right and left tributaries of the Yenissei. The confluence of the river Abakán with the Yenissei may be considered the lowest point of the whole area.

With the exception of the northern limit of the area in question, which is a conventional one, all the other limits are clearly marked by the watersheds, surrounding the drainage. In the west there are the wild and little known summits of the Seylikhem Mountains, dividing the waters of the left head-river of the Yenissei—the Kemtchik—from the sources of the Obj (the Tshulyshmán and tributaries). In the south the marked chain of Tangnu-Ūla, (Noyonsky Hrebet) forms a slightly northward bending divide between the Uriankhai basin and the great depression of the northwest Mongolian lake region, which last, it will be remembered, has no outflow. Tangnu-Ūla is thence a part of the continental divide between the drainage to the Arctic Sea and the Central Asian outflow-lacking regions. In the east the limit follows the watershed between the heads of the Yenissei and the left tributaries of the Selengá river, the latter draining the Khangai and Kentei Mountains to the lake Baikál. The important highland lake Kossogól lies thus outside the upper Yenissei area. The eastern limits of the Yenissei area (the Uriankhai basin) carry the names of Khan Taigá and Ulán Taigá, and further northward, on the western side of the lake of Kossogól, follow the crest of Bain-Ula, a southern branch of Ergik-Targák-Taigá. Further northward (NNW:ward) the limit leads over to Ergik-Targák-Taigá.

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[1] The geographical names used in the text and on the maps are generally spelt according to the local pronunciation, the same forms being also used by Russian cartographers. The names are rather current ones, sometimes quite unlike the original Mongolian or Turco-tatarian forms. Thus the current »BEIKHEM» should be spoken »Pi-khem», the »ULUKHEM» as «Ulug-khem», the »ARTOOL (-SKY) HREBET» probably as »Arty-Ūla» etc. The name »TANGNU-ŪLA» as used by the Editor is generally written by the Russians as »Tannu Ola». The former may, however, better correspond to the Mongolian pronunciation.

As the northern limit of the area we may conventionally regard a line drawn from the northernmost point of the Uriankhai area — the sources of the Dshebash (right tributary to the Khamsará river) —straight westward to the mouth of the Abakán river. From this point the limit may further conveniently follow the Abakán upward to its sources and join the Seylikhem divide at the head of the Malyi Abakán.

Geographical Coordinates.

The upper Yenissei drainage area, thus limited, lies between the following coordinates:

northernmost point (sources of the Dshebash river)	ab.	53° 00'	N Lat.
southernmost point (S of Teri-nūr)	»	50° 00'	»
easternmost point (W of Munku Sardyk)	»	100° 00'	E from Greenw.
westernmost point (Sources of Malyi Abakán)	»	89° 00'	» »

The Main Orographical Features.

The vast land surface covered by the hydrographical system of upper Yenissei and its tributaries is generally a very mountainous country. As already seen, the area is, except in the N, limited by marked mountain ridges, together with the West-Sayan chain forming the Uriankhai basin. This last-named is a depression of clearly Central Asiatic type, but has found an outflow to the N by way of the crosscutting gorge of Yenissei, a remarkable hydrographical anomaly, whose character will be discussed later on. The areal extension of the Uriankhai basin, including the surrounding mountains up to the watersheds, is ab. 150,000 sq. versts. The West Sayans are northward limited by a marked slope toward the Minussinsk steppe and appear as a chain similar to Tangnu-Ūla in the south.

The surrounding mountains have a quite uniform physiognomy: flat-formed upland surfaces of general heights ab. 6,000 feet and the slopes dissected by narrow, rapidly descending valleys. The upland grounds are mostly treeless, but the slopes are covered with luxuriant forests (except the southern side of Tangnu-Ūla). The eastern part of Ergik-Targák-Taigá, the eastern part of Tangnu-Ūla, and also partly the Seylikhem Mountains are jagged, with ever snow-clad peaks of considerably greater heights than the other, flat-topped mountains. Also the water-dividing mountain system between the Beikhem and the Huakhem river basins, the so called Ogarkha-Ūla, has a similar aspect. The eastern alpine sector of the Ergik-Targák-Taigá continues farther eastward into the still higher and more jagged Munku Sardyk range, ending with the giant among South Siberian peaks, Munku Sardyk, 11,500 feet.

Below we may more closely describe the enumerated mountain systems, their physiognomy, altitudes, passes, etc. Also the lowlands and the river valleys will be more exactly characterized.

We may start with the West Sayans. including in this name also Ergik-Targák-Taigá, the immediate continuation of the Munku Sardyk range. The West Sayans as orographical element were fixed on the map the first time by P. Krapotkin (1875). This chain forms really a branch of a greater orographical axis, running from the S end of the lake Baikál NW to Yenissei and generally named the East Sayans, The above named higher eastern part of the Ergik-Targák-Taigá is rather a sector of the latter mountains, but may be treated together with the West Sayans.[1]

When following the chain from the east, one perceives the passes mentioned below, indicating minimum heights of the crest-line:

Uyuk Dabán	(min) 7,000	feet
Tengyss Dabán	6,940	»

---

[1] Regarding the name West Sayans it may be mentioned, that this is of a quite recent date, being used the first time, as far as I know, by Ed. Suess (1901). Later on the Russian explorer G. E. Grum Grshimailo (1914) has also accepted this name. The best expert in South Siberian orography W. A. Obrutcheff (1911) seems, however, to avoid this, and speaks only of the »Sayans», using special names for the different ridges.

The name Ergik-Targák-Taigá, applied to the higher eastern part of the chain, to the NE of the Uss area, was known a long time ago, and is used also by the local inhabitants. It was mentioned already in a treaty between Russia and China in the year 1727.

On the map 1912 published by W. M. Rodevitch comprising »the basin of the upper part of the Yenissei river» there is only a single chain, »Hrebet Sayansky» composed of Ergik-Targák-Taigá and the West Sayans, while the continuation of the East Sayans to the NW is unnamed.

Sai-hen Dabán	6,194	feet
Mongol Dabán	6,470	»

These passes are all situated on the sector between the headwaters of the Oká river in the NE and the right sources of the Shishkit (right head arm of the Huakhem) and the Beikhem. They are all difficult to climb and but little used. Farther westward along the main chain the passes are at greater distances one from another and are named as follows:

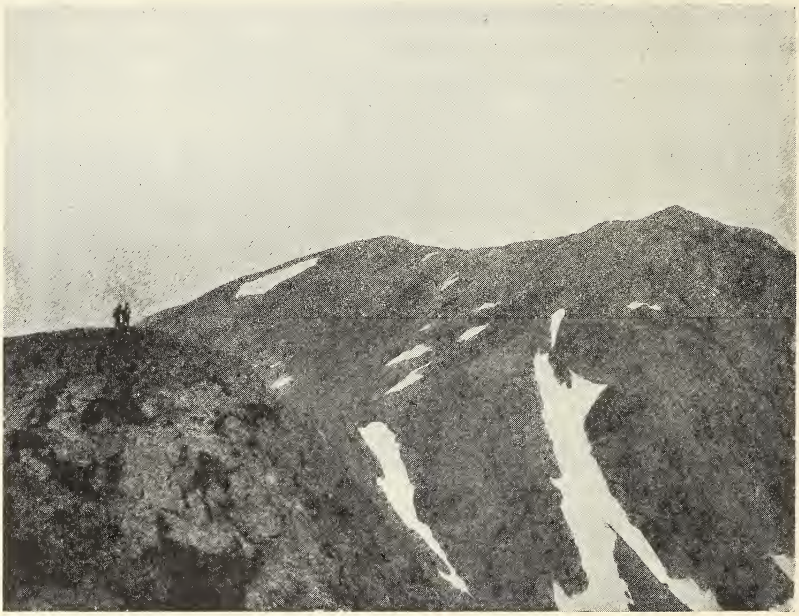

Fig. 1. One of the summits of the Ergik-Targák-Taigá near to the Amyl-pass (sources of Sistikhem). Old crystalline rocks.
Pict. communicated by *H. Printz.*

Musstag Dabán	6,910	feet
Algiak pereval (pass)	4,200	»
Kulumyssky pereval	3,655	»
Kurtushibinsky pereval	6,070	»

Farther westward the mountains are suddenly cut off by the cross-going gorge of the Yenissei. On the western side of this interruption the ridges rise again to still greater heights. The passes here are:

Shabin Dabán	6,835 feet
Aray Bashi pass	6,170 »

The summits of Ergik-Targák-Taigá are generally more than 7,000 feet ab. the sea and most of them are jagged and ever snow-clad. Measurements have been made in a few cases besides the passes enumerated above. The Tashty Mountains to the N of the sources of the little river Ak-suk (flowing to the Beikhem) rise to 8,500 feet ab. the sea. Where the main chain bends from its NW:ly direction to the SW, the alpine summits reach the height of ab. 10,000 feet. Farther southwest the chain is considerably lower. At the Algiak pass the summit of Ottyg Tasküll measures only 5,740 feet. The ridges of the Uss-area are somewhat higher (head of Buibá 6,340 feet) and some peaks rise even to considerable heights (8—9,000 feet) as the so called Bereozovy Tasküll, not far from the northern entrance to the Yenissei canyon and on its right side. The heights of the »Goltzy» (barren summits) of the southernmost ridge in the Uss-area, the Kurtushibinsky Hrebet, vary between 7,500 feet and 9,200 feet.

The abs. height of the water edge in the Yenissei gorge at the mouth of the Kemtchik river (Kemtchik Bom) is according to recent measurements 1,640 feet.

As regards the heights of the summits in the mountains to the of W the Yenissei gorge I have no knowledge of details. In general the ridges and peaks get gradually higher to the west, where they join the alpine systems of the Seylikhem Mountains. The summits here are mostly snow-clad all the year round.

Finally the sculpture in a broader sense of the mountain system in question: the distribution of the ridges, peaks and valleys, remains to be spoken of.

Ergik-Targák-Taigá is a rather marked crest line, showing a great number of alpine formed peaks most of which stand far above the snow limit, and are of the same physiognomy as the still higher Munku Sardyk range in the east. There are, however, also on both sides of the main watershed large areas of considerable mountain ranges, which play the part of secondary watersheds between the numerous rivers descending from the general divide. When following the southwesterly directed sector of Ergik-Targák-Taigá toward the Uss-area, one meets a virgation of the main chain into several ridges: the Kulumyssky Hrebet in the north, the Bolshoy Oisky Hrebet, the Aradansky Hrebet between the rivers Kazyrsuk and Tepsel and the Mirskoy Hrebet between the latter and the Uss river. To the south of the last mentioned lies the important branch of the West Sayans, Kurtushibinsky Hrebet, joining the B. Oisky Hrebet at the headwaters of the Uss river.

As already mentioned all these ridges are separated by deep valleys, cut off to the W by the Yenissei gorge, into which the Kazyrsuk, the Tepsel and the Uss fall.

On the western side of the Great Gorge the Soyotsky Hrebet or the Tasküll forms the real continuation of the Kurtushibinsky Hrebet. To the N and W of this chain there extends a complicated system of high ridges, produced by the deeply cutting valleys of the Kantegir (tributary on the left side of the Yenissei Gorge), the Aná (right tributary of the Abakán river), and the Malyi Abakán. The ridge between the two latter rivers bears the name of Hrebet Tshuktshut. This ends in the N with a mountain ridge, Khandsyn with the goldbearing Shamán Tasküll.

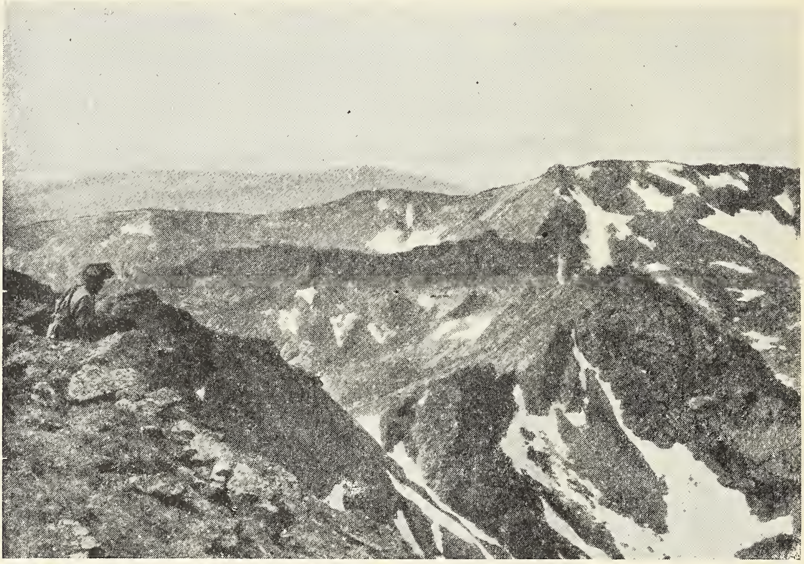

Fig. 2. Main crest of Ergik-Targák-Taigá near the sources of Sistikhem. Massive crystalline rock ground. Note the advanced stage of head water erosion. Picture taken towaid the West(?)

Pict. communicated by *H. Printz.*

The Seylikhem Mountains bordering the Uriankhai depression to the W are, as is known, a far southward reaching range, being the divide not only between the Kemtchik and the Tshulyshmán but also between the drainage of the Kobdo rayon and the Katún river. In the N part (N of the junction of the Tangnu-Ūla) there are the following passes (from N to S):

Pereval Baisy	7,688 feet
Honin Dabán	5,720 »
Tshapgan Dabán	10,560 »

The peaks here are wild, snow-covered and but little known.

Between the longitudes 90° and 97° E of Greenwich and bending somewhat N:ward from the 50° parallel so as to form a gentle arc there extends the great chain of Tangnu-Ūla, which is, as mentioned above, the real divide between the Mongolian outflow-less area and the Arctic drainage. On the best existing orographical map, the »Asiatic-Russian southern frontier zone map» (scale 1: 1,680,000), this mountain chain is drawn as a uniform ridge with plume-formed arrangement of the drainage. In reality the relief here is far more complicated, as shown below.

Regarding the heights of Tangnu-Ūla there are the following passes (from W to E):

Hundurgún pass	6,660 feet
Kuile pass	7,740 »
Bain Tangnu	6,820 »
Eleges pass	6,760 »
Khamár Dabán	4,620 »

The summits of Tangnu-Ūla are generally not much higher than the passes, because nearly the whole chain has an even crest, manifesting itself from a greater distance already by a nearly horizontal sky line. In reality the chain has the form of a highland plateau, dissected by deep valleys, rapidly descending on both sides from the longitudinal divide. The N and S slopes are well marked, and from a greater distance the mountains give the impression of a typical chain or ridge. Following the chain farther eastward, one finds that the heights are increasing, so as to form real alpine summits, ever snow-clad, in the regions to the S of the upper left tributaries of the Huakhem. Here the chain is already less individualized, joined on both sides by vast mountain complexes. GRUM GRSHIMAILO in his recent paper on the geography of the Uriankhai (1914) has therefore considered the 96° Long. as the real end of Tangnu-Ūla (i. e. in the vicinity of the Khamár Dabán pass), while the high mountains to the east rather form a part of the Khangai system.

The upland plateaus of Tangnu-Ūla are never snow-covered in the summer months. The mountains are considerably drier than the West Sayans, especially on the southern slopes.

Nearly all the valleys of Tangnu-Ūla are deeply V: shaped gorges with a rapidly descending curve. They have often a winding course, controlled by great fissure lines. Also more open, flat-bottomed longitudinal or intermontane valleys occur, causing local centres of drainage (for inst. the valley of Karakul). When standing on the divide of Tangnu-Ūla, one obtains an impression of an irregularily dissected table land, not having the slightest resemblance to a real mountain chain, such as the whole block appears from an outside point at a greater distance.

The greater eastern part of Uriankhai is filled with complicated systems of mostly lofty mountains. The bordering ridges are as follows:

Khān-Taigá, forming a northward continuation or rather virgation of Tangnu-Ūla, where it may be considered to end. From the lake Terinūr the chain appears as a high jagged range, rising above the timber-line. It was crossed by Potanin (1883) in the Agashy Dabán pass (7,090 feet).

Ulán-Taigá, being the farther continuation to the east of the former range. This mountain has the shape of a lofty table land, rising also over the line of forests and carrying perennial snow spots. About its absolute height nothing is known. Potanin crossed the watershed somewhat more to the east, where the Ulán-Taigá joins the complex of the Gurbán Huakhem. This pass, named Iren-Dabán, lies 6,835 feet ab. the sea.

To the N from the mountain Gurbán Huakhem run, according to Potanin (1883), two parallel chains of lofty jagged outlines, the Hardyl Sardyk and the Bain-Ūla range, the latter rising immediately from the western shore of Kossogól. The former has abs. heights of 7,200—8,000 feet. As regards the latter, only one peak has been measured which rises close to the easternmost source of the Yenissei basin and attains 8,300 feet ab. the sea level. The peak dominates the whole scenery to the W of Kossogól.

The Bain-Ūla joins N:ward the Munku Sardyk range. We have thus followed the mountain divides around the whole Uriankhai basin. There remains yet a slight study of the mountains filling the eastern part of the named basin.

The most important element here is the chain of the Ogarkha-Ūla, dividing the Beikhem river area from the Huakhem river system in the south. On the existing maps (40 versts: 1 inch) the Ogarkha-Ūla has the shape of a single ridge, which branches from the eastern part of Ergik-Targák-Taigá and extends in westerly direction to the vicinity of the confluence of Beikhem and Huakhem. In reality this mountain system seems, however, to be far more complicated, at least according to the surveys of Kryloff (1903) and Backlund. There is not only one chain, but several parallel and subparallel ridges. The main divide follows rather a table-formed upland surface. In parts, however, lofty peaks of alpine shape rise far above the snow limit, as can be seen from many points outside the mountains. Kryloff (1903) measured the following heights on his route:

A Tshalyg Art Tyi	6,860	feet
Pass betw. Pitchi O and Ulu O	5,774	»
Peak, N Ottyg Taigá	8,475	»

Alpine shaped, snow covered summits were seen by Kryloff at the sources of the Pitchi O, perhaps the same as the above named. On the map, scale 40 versts to 1 inch (1: 1,680,000), of the Russian General Staff there is a branch of the Ogarkha-Ūla, extending in WSW direction toward Huakhem and called »Gastandu-Taigá». About the real existence of this range nothing is known, however.

Between the numerous tributaries of the Beikhem and Huakhem, descending N:ward and S:ward from Ogarkha-Ūla, there are high mountain ridges with decreasing heights reaching down to the main rivers. Toward the upper Beikhem the slope is, however, very abrupt, caused by the existence of a flat basin in this part of the Beikhem area.

Between the western part of the Ogarkha-Ūla complex and the near lying part of the West Sayans there is a link, a great mountain barrier, cut across by Beikhem in a deep gorge. The name of the barrier, the existence of which was first proved by the Norwegian scientific Expedition (1914), is Tasküll or Artool Mountains. It divides also the upper Beikhem steppe area from the central Uriankhai basin.

The uppermost part of the Beikhem drainage area is filled with an extensive system of lower ridges, separated by smaller and greater rivers and lakes. The area is but slightly known. [1]

Besides the enumerated mountains with their valleys the upper Yenissei drainage area contains a number of open basins of steppe-character, surrounded by mountain slopes on nearly all sides. When going from west to east we meet such an open area in the Kemtchik river basin, separated from the next one to the east, the central Uriankhai steppe, by the quite low Hrebet Kemtchiksky. The latter basin occupies a considerable space between Tangnu-Ūla and the outliers of the West Sayans. To the east it is limited by the gradually rising mountainous country, east of the Bren river. The northernmost end of this basin reaches along the Beikhem up to the above named Tasküll or Artool mountains. The surface-forms of the area in question are variously shaped. Even rolling ground is met with from Ulukhem, traversing the whole area, to the N foot of Tangnu-Ūla. Westward from the Eleges river the topography gets more broken and nearer Tangnu-Ūla even mountainous. Along Ulukhem is extended, however, a fringe of plain land with embayments to the south (the Tarkholik and the Dshakul steppes). To the N from Ulukhem the landscape is also hilly with several marked ridges (the Irbek Mts etc.). There is a narrow prolongation of this steppe to the ESE in the broad valley of the lower Huakhem nearly up to the mouth of the Bren river.

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[1] The area has been traversed by Kryshin (1858) and Kryloff (1892).

Another great steppe-basin is met with in the upper Beikhem area upwards from the Artool barrier. The existence of this relatively low land was proved first by the Norwegian Expedition (1914). It is crossed by Beikhem in a similar manner as Ulukhem traverses the central steppe. The extension of the former basin seems to be not less considerable than that of the last named.

The region of the easternmost sources of Huakhem, — surrounded in the south and east by Ulán-Taigá and the Bain-Ūla range and drained by the river Shishkit (right head arm of Huakhem) is similar open steppe ground, the land of the Darkhats. Its real extension is not exactly fixed, except what can be seen from the map of Potanin (1883), who once crossed the area. The lake Terinūr lies also in a flat country, limited by mountains.

In the midst of the West Sayans there is the deep valley of the Uss river, having in its lower course a broader steppe-like bottom, where the Russian colonist villages of Uss are situated.

Hydrographical Remarks.

The drainage of the Upper Yenissei, inside the limits of the Uriankhai basin, is rather a gathering system for the real Yenissei, which can be said to begin below the mouth of the Kemtchik river (Kemtchik Bom). The junction of the twin rivers, Beikhem and Huakhem in the centre of the Uriankhai basin, could, however, also be regarded as the starting point of the course of the mighty river, which down to Kemtchik is called Ulukhem (the »Great River»). Below the mentioned junction Ulukhem attains a considerable breadth and already here gives an impression of a main river.

We may follow the great waters on their course down the country and begin with Huakhem, the sources of which are situated farthest to the east.

The easternmost head arm of this river system is the Arasay, flowing down a narrow longitudinal valley between Bain-Ūla and the Hardyl Sardyk range to the N and then bending W:ward to the lake Dodnūr, the easternmost head-lake of the Yenissei system. The distance from the Arasay to the shore of the Kossogól in the east is not more than c. 15 versts. The outlet from the lake

Dodnūr bears the name Shishkit, a quite considerable river, receiving several tributaries, e. g. the Tengyss, leading down from the high pass in the Ergik-Targák-Taigá, the Tengyss Dabán. The point, where the Tengyss joins the Shishkit, lies 5,200 feet ab. the sea.

Farther down the Shishkit receives from the south the outlet of the important highland lake Terinūr, the Huakhem river. The latter flows from the lake basin in a deep gorge. Downward from the junction 3,630 feet ab. the sea, the main river bears all the way the name Huakhem.

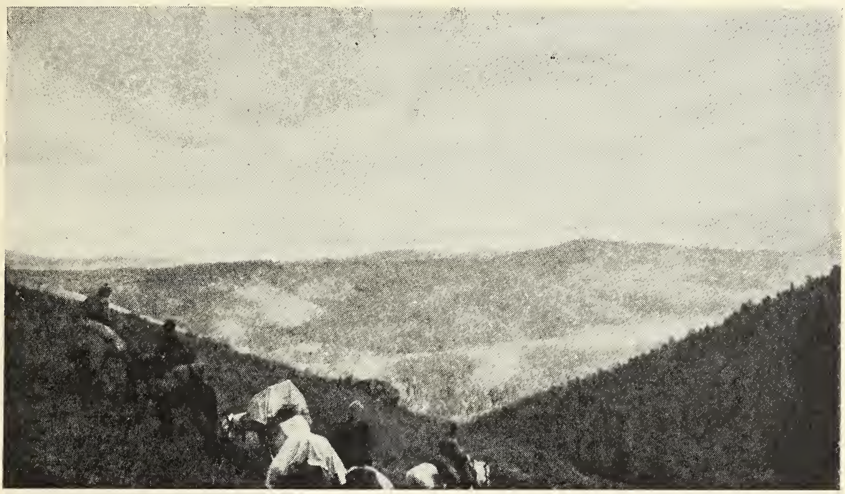

Fig. 3. View toward the E from the mountains at the right side of the Khargin gol river basin. The Terinūr lake basin in the distance.

Photo. St. Foslie.

The lake Terinūr lies, as said in a basin, flatbottomed and surrounded by high mountains in the S and E (see the fig. 3.). Its abs. height is c. 4,195 feet. From the south the lake receives a considerable tributary, the Baligin - gol.

Below the mouth of the Shishkit the Huakhem flows in a narrow gorge, getting broader farther downstream. The shape of a deep mountain valley continues, however, down the course, which recently has been proved by the separate expeditions of Backlund and Foslie.

Behow the mouth of the Shishkit the Huakhem receives a great number of important tributaries on both sides. The southern ones were recognized already by Potanin (1883), who crossed them on an eastward route. Later on they have been more exactly fixed on the map by Foslie (see the itinerary map n:o 3). The northern tributaries have up to a recent date been nearly unknown, until Backlund recognized them (see the itinerary map n:o 2).

The northern tributaries, descending from Ogarkha-Ūla, are as follows (from E to W):

Unshei (with several head arms)
Kongi
Ushep (with the right tributaries: Malyi Ushep, Tshaima and Kunduskuduruk and the left: Kara Ushep)
Shuy
Tersik
Haptá
Baisút

The southern tributaries of Huakhem, following in the same direction from east to west, are:

Khargin gol.
Tarbagatai (with the left trib. Haptagai)
Uluk Dshivei (with Pitchi Dshivei)
Sidzim
Bilbei
Bren (with the the left trib. Shurmak, receiving from the west Madshalyk, the outflow of the freshwater-lake Dshagatai kul (Rybnoie osero), lying at the N foot of Tangnu-Ūla).

All the last enumerated rivers drain the N slopes of Tangnu Ūla and seem to be less rich in water than the rivers descending from the opposite side of the Huakhem basin.

The arrangement of the Huakhem river system is more or less plume-shaped.

It remains still to follow the main stream, the Huakhem, on its course downward from the Bilbei cataracts. It has been pointed out above, that this river in nearly its whole upper course runs in a typical mountain valley or rather gorge, showing also several more open spaces. Downstream from the mouth of the Bren the valley changes its shape, getting considerably broader with partly lower walls. There has been formed a subrecent floodplain of varying breadth, which nearer to the mouth of the river gets the character of an open steppe (see above). The course of Huakhem is on the lower levels quite winding, and in the flood plain there are several dead arms. On the whole the river flows, however, remarkably straight WNW.

The Beikhem drainage system has a far more complicated arrangement. The main river Beikhem originates from the mountain lake Karabuluk, lying not far from the Ergik-Targák-Taigá watershed and the Tengyss pass. From the named lake Beikhem runs in westerly direction — with many bends

— to the vicinity of the 96° Lat. and turns then suddenly northward. Farther downstream the course describes a great bow, the lower course being directed W — SSW — S with many sharp turns and swings. The junction of Huakhem describes a great angle.

The Beikhem river is richer in water than Huakhem, this being due to the greater number of important tributaries, coming from the rainy and lake-rich slopes of Ergik-Targák-Taigá. The greater ones join Beikhem on the right side, being as follows:

Bashkhem

Dorakhem (with the lake Todshi-kul in its middle course). The upper part of the river is called Azass. Ysuk (draining the water from a whole series of lakes).

Khamsará (the most important of all tributaries, having several feeding arms and — lakes in the upper slopes of Ergik-Targák-Taigá). This river receives also from the right many torrents (from E to W):

Bedyi
Kilikhem (with many side arms)
Kadros
Dshebash (with many side arms)

Other right affluents to Beikhem are:

Sistikhem (with the head arm Algiak and many other small tributaries)
Seibi
Utt
Odsha-khem
Uyuk

From the left side the tributaries are all quite insignificant. The following may be enumerated:

Dusaga
Karallyk-khem.
Kuku-khem (the largest one)
Urensuk
Ulu O (Bolshaya Podporoshnaya). This river receives from the left Pitchi O (Malaya Podporoshnaya)
Tapsá (with Karakhem from the right).

Along the course of Beikhem the landscape has a varying aspect. From the upper mountainous part the river enters a flat country, mostly of steppe character, extending downstream to the mouth of Seibi. Farther downward the river runs in a wild gorge crossing the mountain wall of Artool or Tasküll. Here the dangerous Utinsky Porog is situated. The lowermost part of the course is again calm and meandering, now already reaching the central Uriankhai steppe.

The drainage area of the Dorakhem — Ysuk — Khamsará is generally mountainous and the land forms show influences of former glaciation (moraine ridges, etc.). The whole lower part of the Sistikhem valley is open and flat and belongs to the steppe area of the middle course of Beikhem. The upper part of Tapsá is a mountain river, the lower ends in the steppe. Uyuk runs nearly exclusively in the steppe.

From the Beikhem — Huakhem confluence Ulukhem flows as a mighty river in a westerly direction through the central Uriankhai steppe and joins, somewhat below the entrance into the Great Gorge, the Kemtchik river. The course is generally winding inside the limits of a quite extensive floodplain, bordered on both sides by bluffs of varying heights. In the upper part of the river the walls are steep, but only some ten m high. Downward the right slopes grow higher and soon assume the aspect of real mountain sides, being the southern spurs of the Kurtushibinsky Hrebet. Water gaps are present at the characteristic limestone rock of Haerkhan and at the Obo Mountain near to Ust Shagonar. Above these passes the river is highly meandering and forms also a great number of arms and alluvial islands (see the figure 4). The tributaries of Ulukhem (between the junction and the mouth of the Kemtchik river) are small and insignificant, due to the dry character of the country crossed. Ulukhem plays therefore the part rather of an outlet stream for the precipitation—area in the eastern part of Uriankhai. On the right there are the following small streams:

Baien-gol
Irbek
Baien-gol
Idshim
Temirsuk
Ilikhem (Serlikh)
Kurlikhem
Ortatkhem
Dshingá
Yurgún

} all draining the S side of the Kurtushibinsky Hrebet.

Many of these are well known among the goldwashing people of these countries. The washing business here has, however, ceased. — The southern tributaries are few, but larger, and drain the N slopes of Tangnu-Ūla. The most important is the Eleges river with its many head arms. These last mentioned are quite rich in water, but because the main river in its lower course crosses a dry steppe, only a part of all the drained water reaches Ulukhem. To the west of the Eleges the Barlyk and Baien-gol are drawn on the map.

They are, however, mostly dry beds. Further westward there are the twin streams Arr-Tarkholik and Shagonar, both descending from Tangnu-Ūla. A tributary to the Shagonar is Kuile. To the west of these rapidly flowing streams is the Dshakul river, also rising in Tangnu-Ūla and crossing the Dshakul steppe. The river reaches Ulukhem just above its entrance into the Great Gorge.

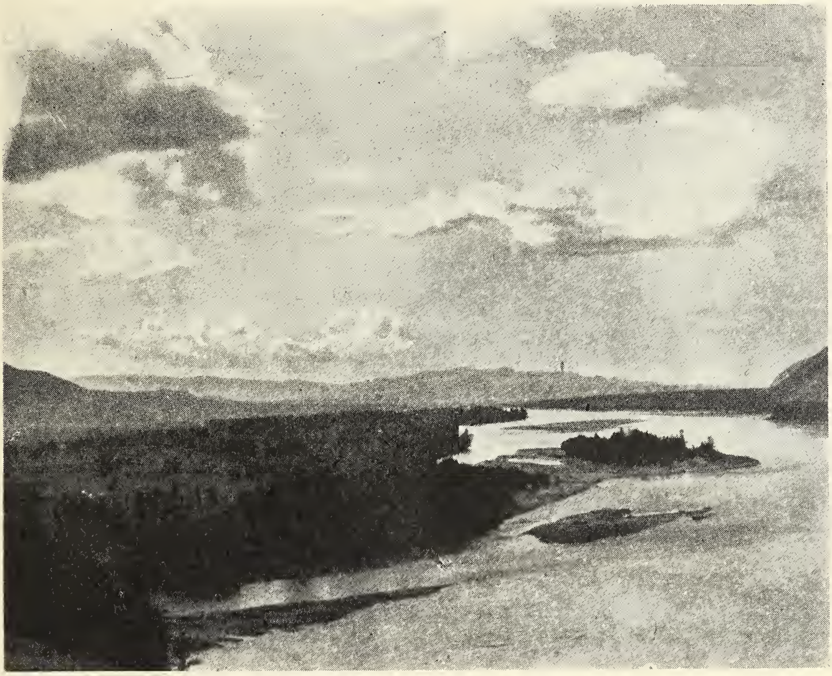

Fig. 4. A view down Ulukhem at the mouth of Eleges (to the left in the foreground). The slopes to the right and left consist of the table land formation. In the distance there are hills and ridges of the basement structure of older rocks (pre-Devonian), rising westward from beneath the table-land formation. Looking W.

Photo. H. Hausen.

The Kemtchik river area is a well isolated drainage basin leading to the Yenissei Gorge and consequently in a more exact sense lying outside the Uriankhai basin system. The main river originates in the Seylikhem Mountains, not far from the pass Kara Tshezyrkhan. The general course is toward NE. The greater part of the tributaries come from the left side, the moist slopes of Seylikhem. The most important are (down the basin):

Allash (draining through head rivers the lakes Terikul and Karakul)
Aksuk

Bolshoy Ishkhem
Malyi Ishkhem

On the right side there are the head arms S of the sources of the Kemtchik, Malaya and Bolshaya Tshuya and more to the east Barlyk. Further downward are the Dshirgak and Dshadan rivers, both draining the slopes of Tangnu-Ūla.

A great part of the course of the Kemtchik river goes through an open steppe (see above). The lower part is a gorge between mountain sides and ends, as said, in the great Yenissei Gorge at the so called Kemtchik Bom.[1]

The Yenissei cross-cutting Canyon or Gorge is one of the most remarkable water gaps in the South Siberian mountains, and reaches from the N end of the Dshakul steppe northward to the N edge of the West Sayans, where the village Osnatiennoie is situated. The course of the Gorge makes a great S:formed swing, evidently due to fissure lines. The profiles are generally very narrow, partly canyon-like, partly somewhat broadly V:shaped. Elsewhere they also show terraces in more or less complete succession. The fall of the river is on the whole distance of the Gorge considerable, producing rapids on long distances and also foaming falls and whirls. The most remarkable of the rapids, all now navigable by timber floats, are the following:

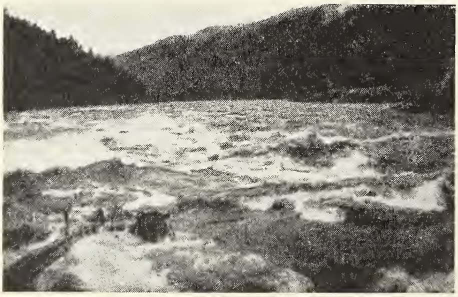

Fig. 5. A part of the Bolshoy Porog (Great Rapids) in the Yenissei Gorge, middle section. Looking downstream. Mountain sides consist of granite. *Photo. T. Hasselström.*

(Uppermost) Staroviersky Porog
Bolshoy Porog (the greatest one, formerly unpassable. See the fig. 5!)
Diedushkin Porog
Bereozovy Porog
Dshoisky Porog
(Lowermost) Mainsky Porog.

Steamers can pass upstream to Bolshoy Porog.

On the space between Kemtchik Bom and the N entrance the Gorge receives several mountain streams, all flowing in deep valleys mostly of a similar canyon like character. The most important ones are the Uss river on the right and the Kantegir river on the left side. The former is a real intermontane river system, causing the branching of the Sayans into the northern chains and the Kurtushibinsky Hrebet. The fall of the river is considerable and the same can be said about all the tributaries, small streams well known among the goldseekers in these regions.

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[1] »Bom» = steep cliff.

The N slopes of the West Sayans are drained by three main rivers conducting the waters centripetally to Yenissei in the Minussinsk steppe:

a) from the right side of Yenissei:

Kebesh (with the left trib. Oia)

Amyl (with several smaller head arms) flowing into the Tubá river, which joins Yenissei at the 54 Parallel.

b) from the left side of Yenissei:

Abakán (with the right upper tributaries Malyi Abakán and Aná draining the high mountains, where the West Sayans join the Seylikhem Mts).

Where these rivers flow in the mountains, the valleys are deep and the falls rapid, but in the steppe the streams are calm with winding courses. The most striking example is the Yenissei, which after the departure from the Gorge with its many rapids suddenly swells and meanders in a sandy bed, forming islands and banks.

When regarding the lakes in the upper Yenissei area it is a striking fact that the Uriankhai basin lacks, contrary to the many other depressions in Central Asia, any extensive stagnant water. The existing lakes are all small and the greater part of these are located in the peripheral mountainous regions. The absence of a central water basin is chiefly due to the quite perfect drainage of the area. Land surfaces not reached by the arms of the Yenissei or its head arms, are of very small extent. One of the most remarkable of these is the Bielotzarsk- or Central Uriankhai Steppe extending between the Bren and Eleges rivers S off Huakhem—Ulukhem. This undulating dry ground contains a number of depressions without outflow. In some of them there are salt-lakes, such as:

Dshider-kul (the largest one)
Kaden-kul
Tuss-kul (with salt-works)
Hak-kul.

A still greater lake, Dshagatai-kul (Rybonie osero) situated at the N foot of Tangnu-Ūla, where the ground waters appear from beneath the gravel fans of the named mountains, contains fresh water and has an outflow to the Shurmak river in the E. This lake is very rich in fish. [1]

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[1] »Rybnoie Osero» = Fish Lake.

Among the lakes in the Huakhem drainage area are the already mentioned Terinūr and Dodnūr. The lake drawn on the map in the middle course of the Haptá river is a dubious one. Its real existence has never been proved.

The upper Beikhem drainage area is the lake region par préférence. As already mentioned, most of the right tributaries to the upper Beikhem as well as the last named owe their origin to mountain lakes, all of glacial origin. Their parallel arrangement is striking, being extended in ENE direction, although many lake axes are otherwise oriented. The most important is the Kara Buluk, the real source of Beikhem. This lake area is not yet definitely mapped.

The S slopes of Tangnu-Ūla are drained by the river Tess to the great outflow-less lake Ubsa-nūr, the northernmost of the Central Asian lakes.

Climatological Characteristics.

A meteorological observatory exists already a couple of years in the administrative centre of Uriankhai, at Bielotzarsk, but the material, collected there, has not been at the writer's disposal. All the reports have been transmitted to the Central Observatory of Siberia at Irkutsk, but are still unpublished. In the following pages the author can therefore not use this exact and continuous material, but is referred to earlier published data and to own sporadic observations.

According to Afrikanoff [1] the conditions in general are of purely continental character, showing sudden changes from cold to warmth and vice versa. Regarding the middle temperature, the area demonstrates some differences in different parts. The eastern mountainous regions are considerably colder than the lower lands to the west. The Kemtchik area is already temperate warm, a fact proved by the aspect of the flora, which also is earlier developed in the spring time. Already in the beginning of April the steppe gets a green carpet and the trees are leafing, while in the eastern mountain valleys the vegetation is still undeveloped.

The Ulukhem river is free from ice in the middle of April and freezes in the middle of November. Already in the middle of October there is an ice drift on the rivers, caused by the breaking up of the first shore-ice sheets, which are very dangerous to navigation, because the pieces in narrow passages of the river are packed together.

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[1] A. M. Afrikanoff: »The Uriankhai Land and its Inhabitants» (А. М. Африкановъ: Урянхайская земля и его обитатели. Извѣстія Вост. Сибирскаго Отдѣла И. Р. Геогр. Общества. Томъ XXI. № 5. Иркутскъ 1890), page 47.

The changes of temperature are, as said, very considerable. In winter days the thermometer reaches frequently — 30°—40° C, while summer days show 40° C above zero. The summer nights are rather cold on the steppe, but in the taigá much warmer. Regarding the summer temperatures some of my own observations may be published here (swing thermometer):

Year 1918.	Date	Locality	Time	Temperature C.	
	June 17	Haptá	$1,\underline{30}$	+ 25°,0	(sunshine)
	» 18	»	6,30	+ 12°,0	»
	» 29	Hlebnikova	$4,\underline{20}$	+ 18°,0	»
	» 30	»	7,20	+ 9°,0	»
	July 1	Ust Bren	$3,\underline{45}$	+ 25°,0	»
	» 9	Atamanoffka	9,45	+ 20°,0	»
	» 9	»	$4,\underline{00}$	+ 30°,0	»
	» 10	Bereozoffka	5,30	+ 12°,0	»
	» 23	Div. Tangnu-Ūla	5,35	+ 10°,0	»
	» 23	» »	$1,\underline{45}$	+ 20°,0	»
	Aug. 17	Ust Shagonar	$1,\underline{00}$	+ 25°,0	»
	» 17	» »	7,00	+ 15°,0	»
	» 18	» »	6,50	+ 15°,0	»
	Sept. 3	Turán	7,20	+ 18°,0	»
	» 3	Turansky Tasküll	11,00	+ 15°,6	»
	» 6	Pass B. Oia	11,29	+ 5°,0	(clouds)

These dates show nearly all the more or less immediate results of the insolation both in the vicinity of great rivers, in mountains (crest) and on the dry steppe. In general the sunshine is much more intense in the steppe than in the mountains during the summer months, because the sky over the latter is frequently clouded. In Tangnu-Ūla I have observed heavy outbursts of rain and even hail in the middle of the warm season. The hailstones have frequently the size of billiard balls and can kill the cattle.

According to AFRIKANOFF (l. c. page 47) the dominant winds come from N and NW, i. e. from Siberia, passing over the Sayan Mountains.[1] They bring moisture with rain and snow, while southern winds are dry. The greater part of the precipitation brought by the northern winds is, however, caught by the Sayan chain, as is seen from the luxuriant growth of the forests there. The Tangnu-Ūla is, as stated above, generally much drier (see below regarding vegetation). The only condensation is produced by the northern winds, after they have passed the steppe region, and thus only the northern slopes are furnished with moisture. The southern sides are already nearly as dry as the Mongolian steppes further in the same direction.

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[1] The same fact is also pointed out by RODEVITCH (1912, page 144).

The West Sayan chain may thus be regarded as the real divide between the humid mountainous taigá region of the Southern Siberia and the Mongolian steppes. Tangnu Ūla is rather an oasis, a quite isolated condenser of moisture in the latter region, like the Khangai and the Altain-nūru of the interior.

A similar condenser is also the Ogarkha-Ūla and many of the higher ridges in the eastern part of the Uriankhai area. Between them there are often quite dry steppe—like valley depressions.

General Features of Phytogeography of the Area.

The climatic conditions, above shortly characterized, are quite well illustrated by the landscape physiognomy, produced by the various associations of trees and plants. These sides of the upper Yenissei nature have been relatively well studied (KRYLOFF 1903, SHISHKIN 1909, and PRINTZ 1921). The first named has also measured numerous altitudes of the limits of various trees. PRINTZ has more systematically examined the taigá of the West Sayans and the steppes to the S of them. I will therefore in the first place refer to the good descriptions and the excellent pictures of the last mentioned paper.[1]

To give a more correct idea of the phytogeography of the Sayan area some statements of PRINTZ (op. c.) may be cited.

Regarding the part of the Minussinsk basin, lying immediately N of the foot of the West Sayans this writer says: »The tract - - - - may really be considered as a transition zone between the steppe and the virgin forest further south: it forms what is called by the Russians wooded steppes, stretches with dry open woods, composed chiefly of various foliage trees — — birches, poplars, and others, partly also larch — — diversified by larger or smaller steppe-like areas between them.» The forests — the taigá — meets in many tracts very suddenly. »In places, especially on level land, there is often a remarkably sudden transition between the steppe and the taigá. The border of the primeval forest extends in a direct line. As if cut with a knife, only a few steps, and the traveller from the sunny, open steppe enters the moist twilight of the virgin forest.»

PRINTZ makes the following subdivisions in the phytogeographical region of the upper Yenissei:

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[1] H. PRINTZ: Vegetation of the Siberian-Mongolian Frontier Mountains (The Sayansk Region). Trondhjem 1921.

1. The subalpine taigá or forest territory, comprising the Siberian N side as well as the Mongolian S side of the West Sayans, with a marked subarctic flora.

2. The alpine region, comprising the loftier mountain tracts above the tree limit (about 1800—1900 m. ab. the sea level) of the West Sayans, where arctic species of plants are prevalent.

3. The lower steppe area about the Ulukhem, mainly with a Mongolian or Central Asiatic stamp (the Central Uriankhai steppe).

4. Between 1. and 3. there is the wooded steppe region, a transition zone between the lower steppe areas and the subalpine taigá territory.

In this connection reference may also be made to the sketch map III in Printz's paper showing the areal distribution of the enumerated regions.

The subalpine forest consists of the following main trees:

Picea obovata
Abies sibirica
Pinus cembra. var. *sib.*
Pinus silvestris
Larix sibirica
Betula pubescens
Populus tremula
Populus laurifolia
Alnus fructicosa
Prunus padus, etc.

According to Printz there is a conspicuous phenomenon of the drying up of the primeval forest, indicating the approach of less moist climatic conditions than in past times. The steppe may be said to gradually push forward into the forest.

The alpine vegetation is, as the same author states, very rich and luxuriant, especially in sheltered places, while the wind exposed mountain sides are barren.

Southward from the Sayan Mountains *Larix sibirica* is more common, especially in the transition lands between taigá and steppe. The more hilly, not very mountainous parts of the Uriankhai area all show very characteristic features in the sense of forest distribution. All the southern slopes are open steppe grounds, while the N declivities all carry dense, but park-like woods of *Larix sibirica* reaching up to the top of the hill. When regarding such a landscape from the south, one gets the impression of a barren, dry country — the woods being invisible. But turning the eyes into the opposite direction one seems to be in the midst of a hilly taigá. No doubt, the barren S slopes are dried up by the burning sun. Already early in spring the snow has disappeared from the south-facing sides, while it still remains on the N slopes, causing a moisture of long duration.

About the steppes Printz gives the following characteristics: »In spring these steppes and wood-steppes are said to be covered with a luxuriant grass vegetation, which is gradually destroyed by the drought in the course of the summer. In the second half of August these tracts have already an autumnal appearance, the first nights of frost having also in a great measure ruined the vegetation.» — — Greater parts of the steppes are even grass grounds with a fertile black soil (tshernosiom), other parts again could rather be called rock-steppes according to WARMING. The common steppe shows transitions through the shrub-steppes to the xerophil steppe.

The subalpine forests seems to be the dominant in the higher eastern mountains of the greater eastern part of the Uriankhai basin, but in the lower and broader valleys the more xerophil *Larix sibirica* is already the characteristic form.

In Tangnu-Ūla the conditions are rather more uniform. These mountains are, however, not, as PRINTZ states[1], »a dry and woodless mountain ridge, practically destitute of forests right up to the summits, only the N side in the greatest elevations being clad here and there with small patches of wood, especially of larch», etc. On the contrary Tangnu-Ūla is covered by dense forests from the N foot up to a marked timber line. All the valleys descending to the N are overgrown with luxuriant taigá and also an under-vegetation. But the great variety of trees met with in the Sayan primeval forests, is lacking in the greater parts of the slopes. The dominant tree here is *Larix sibirica*, which in more sheltered places reaches giant dimensions. In moister places other coniferous trees are added and also birch.

About the height of the timber line KRYLOFF (1906) has made some measurements. In the upper regions the larch is getting scarcer and the *Pinus cembra* var. *sibirica* marks the real limit of the forests. The level to which the larch reaches in the Eleges pass was measured by KRYLOFF as ab. 1700 m. The cedar does not go much higher than 2150 m. Between these two levels the forest is, however, already very thin. Storm winds destroy many times larger or smaller areas of these woods. On the S sides of Tangnu-Ūla downward the timber is getting thinner and further down barren slopes are predominant. In the Tarkholik pass (farther E) the tree limits are quite the same.

The region above the timber line in Tangnu-Ūla is tundra-like ground with even configuration and scarce outcrops of the bed rock. The soil is stony and marshy with characteristic flow-movements down the slopes. The thin vegetation cover has an arctic (alpine) character.

In the lowlands along the greater rivers there are »gallery woods» chiefly of poplar (*Populus laurifolia* and *P. tremula*).

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[1] The Norwegian Expedition did not visit Tangnu-Ūla.

Population.

The native population of the Uriankhai country and also of the valleys in the West Sayans is a mingled Mongolian tribe, called by the real Mongols »Uriankhai», by the Russians »Soyoty». The people calls itself »Tubá». Their language is a mixture of Mongolian and Turco-tatarian words. The average number of this tribe can be estimated at ab. 40,000 ind. living to the N of Tangnu-Ūla. The most part inhabits the Yenissei basin, the rest the region of Kossogól, and an insignificant number some valleys in the East Sayans, in the W part of the Tunkinsky Krai.

The Soyots are a semi-nomadic tribe, living in very primitive circumstances, separated as they are from the outside world by high mountains. To the south communication could be somewhat easier, but the Chinese and Mongolian authorities do'not allow the Soyots to pass a demarcation-line, running along the S foot of Tangnu-Ūla and guarded by posts, standing at regular distances one from another, called Karauls.

The greater part of the Soyots keep cattle and live a purely nomadic life. Other groups of these inhabitants dwell in the same places the whole year round and have turned to agriculture, as the Soyots in the Kemtchik valley. In the higher parts of the Ergik-Targák-Taigá there is a special kind of Soyots, the reindeer-nomads, who are not very numerous and very poor.[1]

In the upper Huakhein area, the Land of the Darkhats, there are Darkhats, a Mongolian tribe of ab. 7000 souls.

The Soyot population is divided into nine sub-tribes or Hoshun's. Local authorities are called Noyons.

Side by side with the native population the area is occupied by a fairly numerous and steadily growing contingent of Russian colonists, so called pereselenzy. The pioneers of this invasion were goldseekers and merchants climbing the rough trails over the West Sayans to the unknown South. The first washingworks were started on the S slopes of Ergik-Targák-Taigá already in the 3d decade of the past century and thereafter continued — mostly on a very reduced scale — up to the present times. The intensity of this business has decreased considerably especially in the last decades.

Real land cultivating colonists have invaded the country only at the beginning of this century, first occupying the nearer lying agricultural ground, such as the Uss-valley and the Turán-Uyuk steppe not far from the foot of the Sayans. But year by year the number of pereselentzy increased and the new crowds passed still farther inland founding new colonies, chiefly along the greater rivers. The native inhabitants were pushed aside and moved up to the less fertile mountain valleys. — In the year 1912, when the Russian-Mongolian treaty was made, the whole territory came under the protectorate of Russia and the colonization could be better organized. An administrative centre, named Bielotzarsk was founded at the confluence of Beikhem and Huakhem and was adopted as residence not only for the Comissar and his office and for a cossack-division but also for a colonization—administration (Pereselentcheskoie Upravlenie) which should lead the immigration into right ways and aid the newcomers in every respect. This same organization started also a survey of the territory in the sense of agricultural possibilities, natural history and ethnography.

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[1] This peculiar tribe has been studied by D. CARRUTHERS and described in his: Unknown Mongolia. A Record of Travel and Exploration in the north-western Mongolia and Dshungaria. Vol. I, II. London 1913.

See also: ØRJAN OLSEN: Et primitivt folk. Kristiania 1915.

The most important colonist villages up to date are the following:

- In the Uss—Area
  - Verkhnie Ussinskoie
  - Nishnie Ussinskoie
- In Uriankhai
  - Turán (with post office and hospital)
  - Uyuk
  - Boyaroffka (on Huakhem)
  - Snamienka »
  - Medvedieffka »
  - Potilitzyn »
  - Hlebnikova »
  - Shagonar (on Ulukhem. Factories)
  - Dshakul » »
  - Sosnoffka (on the N foot of Tangnu-Ūla).
  - Verkhnie Nikolsk (on the N foot of Tangnu-Ūla)
  - Atamanoffka (in the steppe N from Tangnu-Ūla)
  - Shoki (on the middle course of Eleges)
  - Vladimiroffka (on the Shurmak river).

In later years some more important goldwashing enterprises were started in Uriankhai, that of Shelesnoff at the Karakhem (Tapsá) and of Tshernewitch in the Urgailik and Shangán valley systems in the middle sector of Tangnu-Ūla. At Baisút the washing works of Leonoff were established.

The terrible Civil Wars in the years 1918 and 1919 disturbing repeatedly the public peace in Siberia influenced also the situation in Uriankhai. »Red» and »white» authorities replaced one another in this country, until the whole area was conquered by the Mongols(?). Any correct information from there has, however, latterly been impossible.

Communications.

As already mentioned the UpperYenissei area and especially the Uriankhai basin lies quite isolated from the outside world, owing to the existence of a great mountain barrier — the West Sayans — separating the more open tracts of the Yenissei Government from the named country. Also to the south the Tangnu-Ūla chain separates the head waters of Yenissei from the Mongolian plains. This condition makes traffic difficult or nearly impossible especially when the snow in the mountains is melting. The best time for travelling here is in the course of the summer.

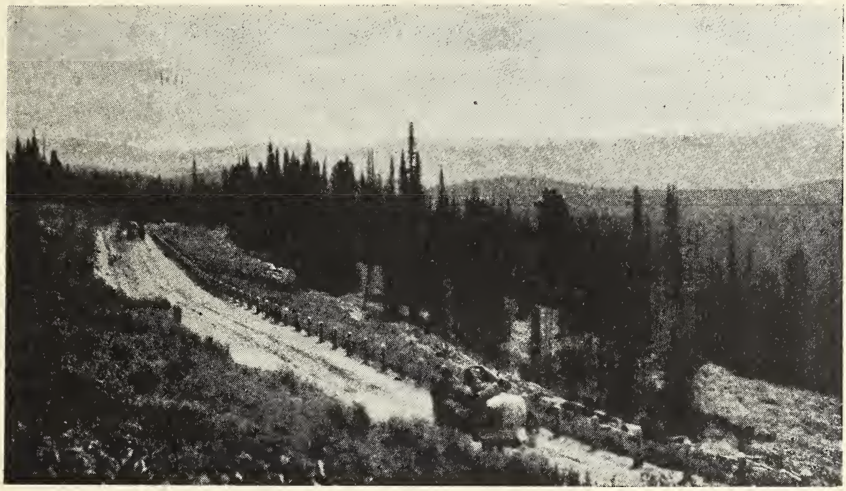

Fig. 6. The newly built post road over the West Sayan Mountains.
Photo. St. Foslie.

In earlier days the goldseekers and the first colonists had to climb on small trails through the »black taigá» and along the wild stream gorges. Nowadays, a carriage road has been constructed, leading from the village Grigorieffka — situated not far from the N foot of the West Sayans on the very border of the taigá — over the Kulumyssky and the Ōia passes down to the Uss valley, which it follows on the right and left sides to the village of Uss (the Uss post road).[1] From Uss there runs a branch on even steppe ground E:ward over the Turansky Tasküll to Turán and also to Bielotzarsk.

A telegraph line has existed for several years between Minussinsk, Uss and Bielotzarsk.

On the Yenissei river navigation is possible only by timber floats downstream, during the months May—September.

The usual road farther southward, into Mongolia goes over the Khamar Dabán pass. This is the ancient merchants way between Siberia and Mongolia in this sector of the frontier. It can be used also by carriage-traffic.

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[1] The road construction was begun during the European War but soon the work was checked in consequence of the March revolution of 1917, and afterwards it has been only partially continued. At present half of the road is completed but the other half (along the Uss river) is now under work. The whole road can, however, be used by carriages.

III. Historical Review of the Topographical and Geological Reconnaissances of the Area.

By H. Hausen.

The Upper Yenissei drainage area as a whole has, excepting some limited parts of the West Sayans, up to a quite recent date been nearly a terra incognita. A number of scientific expeditions have passed through the country on the way to the interior of Central Asia or homeward bound from the latter, but few have had any special intention to explore the Yenissei-headwaters and their area. At the beginning of this century, however, more systematic surveys have been undertaken, not only in the West-Sayans, but also in many parts of the Uriankhai basin, especially after the beginning of the Russian colonization (in the year 1912).

The first scientific explorer, travelling to the Upper Yenissei area was P. S. Pallas in the year 1772 (1776). He did not reach, however, the Uriankhai basin, but visited the West Sayans at Yenissei. The main purpose of his journey was not specially geological, but natural history in general.

After this journey a long time elapsed, before any European scientist again visited the area. In the year 1842 the President of the Imp. Russian Geographical Society, P. Tchihatcheff (1845) was commanded by the Czar Nicolas I to explore the Altai Mountains from natural historical and especially from geological points of view. On the return route from the Altai region T. had the intention to follow the Abakán river downward, but several obstacles forced him to make a great detour through the Kemtchik area and then over the Soyotsky Hrebet down to the Abakán and the steppe.

The route of Tchihatcheff was as follows: leaving the Altai area in the head of the Tshulyshmán valley he crossed the divide of the Seylikhem Mountains and reached the sources of the Bolshoy (Grand) Abakán. From here he turned over to the sources of the Kungi and to the lakes of Dshildiskul. The further route followed the river Karasulúk downstream and Allash, tributary to the Kemtchik river from the left hand. Then he left the upper Allash and turned northward reaching the mountain lake Karakul. From here he passed the main watershed further N:ward and arrived at the Aná river. From here he marched over to the little stream Yunguek, then he passed the valley of Kantegir, further the Samalhi and at last he followed the Tshehán and the Dshebash down to the Abakán river and the steppe.

During this ride T. made numerous observations also in geological sense and compiled the results on a geological map, which unfortunately, has not been at the writer's disposal. It is moreover a nearly impossible task to reconstruct the route of T., because many of the names used by this writer are lacking on the general map (scale 10 versts to one inch). The geological notes in the text of T. are generally very short and do not give any very exact idea of the character of the rocks observed or of the geological structure. This is especially the case with the so called »greywacke», encountered by T. very abundantly on the route in the Seylikhem Mts. Further on in this paper the writer will have occasion to relate the main results of T:s expedition.

In the following year, 1843, E. Hofmann (1847) made a general survey of all the goldfields of importance in Siberia so as to bring some knowledge about the geological conditions of these areas up to that time in this respect wholly unknown. The journey was undertaken on commission of the Russian Direction of Mines and passed chiefly along the great Siberian post road and ended at Baikál. H. made special side excursions to the East Sayans and the Yenisseiskaya Taigá (N from Krasnoyarsk). The Upper Yenissei area was not visited by him, but his observations in the East Sayans — the only up to date existing — are of importance in the sense of a broader synopsis of the Sayan geology.

A geological memoir about the private gold fields in some parts of the Yenisseisk and Tomsk Governments was published by I. Poletika in the year 1860. When the field studies of Poletika were carried on, is not communicated. The paper contains the first more detailed geological characteristics of the Minussinsk basin and its surroundings and also quite minute communications about the conditions in the upper Amyl area (Ergik-Targák-Taigá) and the head region of the Sistikhem.

The first more remarkable event in the history of exploration in Russian Asia is The Great Siberian Expedition (Schwarz 1864), organized by the Imp. Geographical Society of St Petersburg. The field work was started in the year 1855 and finished in the year 1858. During this time several separate expeditions crossed different parts of Siberia in various directions. In the last mentioned year two members of the enterprise, Kryshin and Schwarz, visited also the Upper Yenissei area. The latter, being the leader of the Expedition, travelled from Minussinsk to Grigorieffka (at that time called Verkhny Kebesh) and then up the West Sayans crossing the main watershed and also several smaller one s and arrived down to the Uss valley. Then he continued the route down this valley to its mouth in the Yenissei gorge. This last named was followed by SCHWARZ upward to the confluence of the Kemtchik river (Kemtchik Bom), at that time on the Chinese frontier. From this point S. turned back down the river, continuing the way to the steppe by timber float.

During this ride SCHWARZ collected a quite considerable number of rock specimens, afterward studied by the professor at the University of Dorpat, K. GREWINGK (1864). He gave not only a short geological description of the route passed, but also an accompanying map with indications of the rock-occurrences. Apart from this description SCHWARZ gave a list of all specimens collected and the localities where found (marked by corresponding numbers on the map) giving in themselves an idea of the mountain structure. This is especially the case with the Yenissei gorge, and the enumeration from here is really the only up to date existing »geological profile» of this remarkable natural cut through the whole Sayan structure.

The main results of SCHWARZ were, however, of geographical kind, and the astronomical determinations and topographical measurements made by him, have served to construct a more correct map of the country (all the results were compiled in a general map of Siberia).

KRYSHIN started from Irkutsk and going westward, he passed the sources of Irkut and Oká and climbed the Mongól Dabán pass in the Ergik-Targák-Taigá, thus reaching the uppermost sources of Beikhem (Issyk suk, Azass). Then he travelled down the country to the great bend of Beikhem (above the confluence of Dora-khem). He turned further to the N, crossing the course of Dora-khem, Ysuk and Khamsará. From this river he followed a right tributary of Khamsará, the Hatarsuk upward and reached again the crest of Ergik-Targák-Taigá, which he crossed by the Mustag Dabán pass. After passing the left sources of the Udá he called at the sources of the Biryussá. From here he followed the high mountians to the NW (the East Sayans) crossing a great number of ridges — a very audacious journey — and reached at last the Yenissei somewhat above Krasnoyarsk. KRYSHIN was thus the first traveller after TCHIHATCHEFF, who visited the Uriankhai country.

During his rides KRYSHIN made in accordance with SCHWARZ topographical measurements, astronomical determinations etc. His personal report has not been published but only a summary, given by SCHWARZ. In this short paper there are no geological dates, and KRYSHIN has apparently not collected rock specimens at all. This is a very lamentable fact, regarding the circumstance, that KRYSHINS ride along the whole East Sayans has never been followed by any other of similar kind. The greater part of these mountains is still a quite unknown land in geological sense.

In the year 1879 G. N. POTANIN (1883), the indefatigable explorer of Mongolia, at that time wholly unknown, travelled through the Uriankhai area (through the southern part of it). He came from the south, crossing the crest of Tangnu-Ūla in the Tarkholik pass, reached Ulukhem and followed this river upstream, then up Huakhem to the bend at Bilbei. From here he crossed all the left tributaries to the last named river and passing the lake Terinūr, he left the Yenissei basin in the Khān Taigá. Further on he crossed the land of the Darkhats on the way to Kossogól.

POTANIN was accompanied by the scientist ADRIANOFF (see below) and the topographer, Captain ORLOFF, who was charged with the topographical measurements.

When studying the report of POTANIN one will find an abundance of interesting communications of geographical kind, but very few geological observations. As the main result of the crossing of the Uriankhai basin may be considered a correction of the hydrographical map of the area (see below, page 46).

In the following year 1880 POTANIN visited the land of the Darkhats a second time, when coming from Irkutsk.

A. ADRIANOFF, the above mentioned member of the expedition of POTANIN (1883), etnographer and archaeologist, started in the year 1881 a new expedition to Altai and Uriankhai, sent out by the Imp. Russian Geographical Society. Crossing the Uriankhai country, ADRIANOFF took the following route: from the valley of Bashkaus (Obj drainage) he passed the watershed (the Seylikhem Mountains) and reached the lake Ak-küll, then he crossed the mentioned watershed twice and arrived at the lake Dshulu-küll (the head lake of the Tshulyshmán river flowing to the Teletzk-lake of the Obj drainage). From the lake Dshulu-küll ADRIANOFF crossed the main divide again (highest point here = 10,500 feet in this tract called Shapshal), and then followed the streams Yan-shu and Barlyk down to the Kemtchik river. He continued the route along this river for some distance. Thereafter crossing the Hrebet Kemtchiksky he reached the Ulukhem river at Dshakul. Then he passed along the shore of this river upstream to the confluence of Beikhem and Huakhem, where he turned back and by timber float travelled down to Minussinsk.

In the report of ADRIANOFF (1886) apart from the topographical remarks, there are many geological notes of importance, such as the strike and fall of the encountered rock members. Also collections were made, but these do not seem to have been examined afterward. Only the plant remains from the coal bearing strata of the Central Uriankhai steppe have been studied by SCHMALHAUSEN (see the short report of S. at the end of the paper of ADRIANOFF).

Somewhat later, in the summer 1883 D. A. KLEMENTZ, living in political exile in Minussinsk and very interested in the study of natural history, was adopted as member of a new expedition of ADRIANOFF, this time directed to the southern part of the Kusnetzky Alatau and to the upper Tom drainage area. While A. marched straight over to the Tom basin, KLEMENTZ alone was occupied with the study of the upper Abakán mountain systems, making large collections of rock specimens and plants. The results of the separate journey of KLEMENTZ are published in a report (1891) comprising the following chapters:

1. Journal of the expedition (13 of July—5 of Sept.).
2. List of the collected rock specimens.
3. List of the collected plants.

The petrographical collections form of course a fair contribution to the knowledge of this hitherto in geological sense nearly unknown area. In following chapters the writer will have various occasions to turn to the results of KLEMENTZ.

In the next year KLEMENTZ made a new excursion to the same region, under very difficult circumstances.

During the summer 1885 K. started another journey, this time to the Uriankhai basin. From the Abakán Iron Works he travelled up the river Tshehán to the pass Shabin Dabán in the West Sayans and crossed the Kantegir valley climbing up to the second divide on the way, the Soyotsky Hrebet. After the passage of a third divide he arrived at the river Aksuk, a left tributary of Kemtchik. This river was then followed upward until he reached the factory of SAFIANOFF, situated 6 versts below the mouth of the Allash river (left tributary of the Kemtchik). Starting from this point K. made a longer excursion up the Kemtchik valley to the confluence of the head river Tshuia. The return journey was made up the Aksuk, and the mountains were crossed at the watershed of the Aná river, which he, however, following downward, soon was forced to abandon and cross over to the Tshehán. In such a way he reached the Abakán river.

From this journey only few communications are published (1899). The rock collections are all kept at the MARTIANOFF Museum in Minussinsk, where the writer has been able to study them and also to take duplicates of the most interesting specimens through the courtesy of the Custos of the Museum, MR KASHANTSHIKOFF.

In the year 1887 KLEMENTZ visited Uriankhai the second time. He traversed the West Sayans to the E of the Yenissei gorge (probably along the usual trail employed by the goldseekers) and arrived at the locality where Beikhem and Huakhem join one another. From here he passed down the Ulukhem to Dshakul. This point was the basis of departure for an excursion up the Kemtchik valley and then up Allash to the head lake Karakul -(visited already by TCHIHATCHEFF). Going further upward he crossed the divide of the Seylikhem Mountains and reached the head of the Tshulyshmán river (Obj drainage). Then he crossed over to the sources of the Malyi Abakán and followed the last named river downward to the Bolshoy Abakán, leading down to the steppe. In such a way KLEMENTZ used a route considered by TCHIHATCHEFF as impassable.

Short geological results of this journey are published in French (1899).

In the year 1892 P. N. KRYLOFF (1893, 1903), sent out by the Imp. Botanical Garden of St Petersburg, made an expedition to the Upper Yenissei area with the special purpose of studying the flora of the country. From Minussinsk K. travelled the usual way over the Oisky Hrebet, crossed the Khasyr valley, the rough Aradansky Hrebet and then the no less asperous Mirskoy Hrebet, descending on its S side to the Uss valley floor. This ride was made to the right of the Uss river, while SCHWARZ'S journey followed the other side of the river. From the Uss valley floor (where the colonies now are situated) he did not follow the stream to its mouth, but ascended Kurtushibinsky Hrebet following the valley of the Zolotaya upward. Passing the divide of the mentioned chain he went down again along the Serlikh valley to Ulukhem and arrived at Dshakul. From this locality KRYLOFF made a special (lighter) journey southward, following one of the right tributaries of the Shagonar river upstream and reached the divide of Tangnu-Ūla at an altitude of ab. 2,000 m. Then he descended to the Ubsa-nūr basin in Mongolia. Reaching the shore of this lake he turned back N:ward and crossed Tangnu-Ūla in the Eleges pass (2,060 m). Further N:ward he followed the Eleges river in its upper course, then he left it to the right and traversed the Central Uriankhai steppe straight down to Ulukhem at Ust Eleges.

Ulukhem was then followed upward on the left side to the confluence of Beikhem and Huakhem. Here the expedition crossed Huakhem and continued upward along Beikhem to the Tapsá river, which was followed up to a right head arm. Then he passed the mountain ridge of Tomat-Taigá in the pass A-Tshalyg-Art-Tyi and descended to the valley of Pitchi O (Malaya Podporoshnaya). This valley he travelled upstream and crossing a divide he came down to the valley of the upper Ulu O (Bolshaya Podporoshnaya), which he followed to the sources. Here K. made some side excursions up to the near lying mountains. Further he marched down a fairly abrupt slope to the great plain of the upper Beikhem and reached this river, where a factory of SAFIANOFF is situated.

KRYLOFF continued his journey up to the sources of Azass, and then he turned N:ward to Y-suk, which he followed down to its confluence with Beikhem. After having passed along the right side of the latter, he reached the mouth of Sistikhem and returned over the West Sayans along this river to the Algiak pass and down the Amyl valley to Minussinsk.

Simultaneously with the special work of the journey — the collecting of plant specimens — KRYLOFF made many geological observations and brought home a quite fair collection of rocks. These were afterwards studied by Prof. SAYTZEFF (1896, 1903), who also published a short petrographical report. This report is the first one of importance in geological respect, because KRYLOFF crossed the whole country in two directions. The geological notes from the upper Beikhem area are up to the present time nearly the only existing.

In the year 1902 W. A. OSHURKOFF (1906) made a longer expedition in the mountains to the W of the Kemtchik area. Starting from the Abakán Iron Works and crossing the high ridges to the S he followed the E slopes of the Seylikhem Mountains and arrived at the head waters of the Kemtchik river, passing up the Tshehan over the Sabin Dabán pass, further to the E side of the lake Karakul (head lake of the Kantegir river), the Andsherkul, the sources of the Aná river, the Sur Dabán pass and then over the Karakul lake(?) and along the Koser(?) to the sources of the Kemtchik. Unfortunately the report of OSHURKOFF has not been at the writer's disposal, but only various references to the same in other papers (chiefly in GRUM GRSHIMAILO, 1914). During this journey O. collected a quite considerable number of rock specimens. The course of the return route is not known to the writer.

The following year, 1903 G. E. GRUM GRSHIMAILO (1914) explored areas of the western Mongolia by direction of the Minister of Finance in Russia, State Secretary WITTE. This explorer, known already from earlier journeys in China, started from Saissan nūr, marched over the Altain nūru and followed a route northward to Tangnu-Ūla, which he crossed in its westernmost sector — at the sources of the Kemtchik river. He crossed soon the divide of the Seylikhem Mountains, traversing the Uriankhai territory only in its SW:most corner. Many years later (1914) he published the first tome of a voluminous work named »Western Mongolia and Uriankhaisky krai» containing chiefly a geographical description of these countries. The greater part of this tome concerns the Uriankhai territory, being chiefly a compilation of earlier data and not the author's own results, because, as mentioned, he only crossed the SW corner of the country. The disposition of this paper in question is as follows:

1. Geological notes from the Western Mongolian mountains (an attempt at compilation).
2. Hrebet Altain-nūru.
3. The northern bordering mountains (chiefly the West Sayans).
4. Hrebet Tangnu-Ūla and the mountains filling the Uriankhai.
5. The Khangai mountains.
6. The central part of Western Mongolia.
7. The basin of the upper Yenissei.
8. Rivers descending the SW slopes of the Altain-nūru.
9. Rivers of the Hara-usu lake basin.
10. Rivers descending from Khangai mountains. Smaller basins of the central part of Western Mongolia.
11. The climate of Western Mongolia before and now.
12. The vegetation.
13. The animal kingdom of Western Mongolia.

Appendix 1. — Mineral resources of Western Mongolia (a short enumeration of known occurrences of gold, silver, copper, iron ore, salt, asbestos, coal, graphite and oil).

The chapters 2—6 contain only topographical descriptions with many data ab. altitudes. The chapters 7—10 comprise a description of the hydrography of the area. This paper may be of great use as a book of reference for travellers in the future in the Western Mongolian countries. But any new contributions to our knowledge especially of the Uriankhai basin are not found in the »Western Mongolia and Uriankhaisky krai».

During his journey GRUM GRSHIMAILO collected a number of rock specimens, afterwards studied by the member of the Academy of Sciences at St Petersburg, KARPINSKY, but if the results ever have been published, the writer does not know them.

In the years 1906 and 1907 the Uriankhai country was traversed by the Finnish explorer J. G. GRANÖ (1910). The first time he started his route from Minussinsk, passed over the Ergik-Targák-Taigá by the Algiak (Aldajak) pass, then he followed the Sistikhem and the Beikhem downstream, travelling also down Ulukhem to Dshakul. From here he turned to the south and crossed Tangnu-Ūla in its western part. The second time GRANÖ was on the homeward route from Mongolia and traversed Tangnu-Ūla by the Khamar Dabán pass. Then he followed the Bren and the Huakhem rivers down to the confluence of the latter with the Beikhem, and afterwards he made some weeks study along the Ulukhem westward to Dshakul. The return route from Uriankhai was taken along the usual post road over the West Sayans to Grigorieffka and Minussinsk.

The main purpose of Granös travels was, as is known, glaci-geological studies in the northwestern Mongolian mountains (1910). These observations did not, however, comprise the Uriankhai country. He only collected some rock specimens on his route (afterward examined by Eskola) and made itinerary maps.

During the summer months 1906, 1907 and 1909 the upper Yenissei and its head arms were surveyed by a party directed by the Ministry of Communications of Russia. The leader of the party was Eng. W. Rodevitch, who published some years later, apart from the official results (see the following chapter) a somewhat popular geographical description of the Uriankhai country (1912).

About the same time (year not mentioned) the geologist of the Russian Geological Committee, L. Yatcheffsky (1909) made an excursion to the gold claims situated in the upper Abakán area and surveyed especially the Kyzass gold washing areas. These lie in the Kyzass river system descending the W slopes of the Shamán Tasküll and flowing to the Abakán river. The report of Yatcheffsky contains interesting observations on the lithology of this little known area and about the conditions for gold occurrences.

During the summer months of 1909 and 1910 another geologist of the same Committée J. Edelstein (1912) surveyed the N slopes of the West Sayans, drained by the streams Shadát and Kebésh and published soon thereafter a memoir and a geological map. In a following paper the writer will have occasion to discuss the results of this geologist.

As a consequence of the treaty between Russia and Mongolia in the year 1912 the former got a protectorate over the Uriankhai territory and thus the latter came under the regular geological state surveys of Russia. Every year since then a party has been sent to Uriankhai under the leadership of the geologist Ratchkoffsky, investigating chiefly the Tangnu-Ūla mountains. The last time the party worked there was in the year 1920, by mandation of the temporary Geological Committée of Siberia.[1]

About the results of these long investigations nothing is hitherto known, except a small communication by Smirnoff (1912) corcerning the plant remains found in the coal bearing strata at Ulukhem.

A geologist, B. Porvatoff, living in Minussinsk, undertook by direction of a business man there, in the years 1911—1914 prospecting expeditions to Uriankhai, chiefly to the Kemtchik area, and also to the Kurtushibinsky Hrebet. The results of these investigations are reported in short in two papers (1914, 1915).

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[1] Later on (1922) Ratchkoffsky returned to Uriankhai, by mandation of the Academy of Sciences, Petrograd.

During the summer of 1914 a Norwegian Expedition of naturalists was directed to Uriankhai. The leader of this was the zoologist Ø. OLSEN (1915). The route was taken from Minussinsk over Kushebár up the Amyl river and over the Algiak pass to the Sistikhem valley. This river was then followed to its mouth, whereafter the journey was directed along the right side of Beikhem up to the mouth of the right tributary Dora-khem. Beikhem was passed downstream by timber float and the journey continued in the same way also along Ulukhem—Yenissei down to Minussinsk.

The main results of this expedition, now published, comprise partly ethnography (Ø. OLSEN) partly phytogeography and botany (H. PRINTZ, 1921). In the latter paper there are several important geological communications from the little known Beikhem area. The writer is much obliged to the members of this expedition for their courtesy in placing at his disposal the petrographical collection and some pictures from the route.

During the years 1915—1918 a Russian naturalist, A. YERMOLAIEFF, travelled in Uriankhai, sent as stipendiary from the Krasnoyarsk Section of the Imp. Russian Geographical Society. Later on he was taken into the service of the Colonization office in Bielotzarsk, then making excursions in different directions.

An especially remarkable expedition was made by Y. and his brother, W.P. YERMOLAIEFF to the Kemtchik area. The surveys here comprised a land surface of ab. 20,000 sq. versts. From all the routes Y. collected rock specimens, which are now kept at the Museums in Minussinsk and Krasnoyarsk.

In the summer of 1915 H. G. BACKLUND, then Keeper of the Mineralogical Museum of the Academy of Sciences in Petrograd, was commanded to explore a part of the West Sayans in the vicinity of the Uss- post road. The results of this journey are still unpublished.[1]

In the summer of 1917 the Uriankhai country was visited, apart from the Finnish expedition, by another Finnish party under the leadership of the geologist H. VÄYRYNEN. It was directed to the Beikhem area, the main object of survey and prospecting being the Dshebash river system (right tributary of Beikhem). The return journey was made down the Yenissei. The results of this expedition have not been communicated to the author. If the rock collections and route-maps, made by VÄYRYNEN, and kept in Helsingfors, were published they would bring a fair contribution to the knowledge of a part of the Ergik-Targák-Taigá hitherto wholly unknown.

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[1] Except some small communications (Geol. Fören. i Stockholm Förhandl. Maj 1919. Band 41, Häft. 5. Pag. 391).

IV. Maps Concerning the Upper Yenissei Drainage Area.

By H. Hausen.

The first detailed and critical compilation of the geographical features of Southern Siberia and Northern Mongolia are found on the well known map of Central Asia, edited by J. Klaproth (1836). K. constructed his map chiefly by using chinese cartographical and literary sources. »He was the great conquerer in the Chinese literature», says Sven Hedin.[1] »He collected the material, which afterwards, from a purely geographical point of view, was revised and arranged by Ritter and Humboldt». — »K:s map was practically the best in existence for some 40 years, and all maps of Asia printed in Europe during that time were copied from it.» Regarding the northern parts of Central Asia many corrections in the geographical picture have been made even earlier, as communicated below.

In the year 1855 the General Staff of the East Siberian Army published a map of the southern part of the Yenisseisk Government (scale 25 versts to the inch) with many new corrections based on recent measurements along the Yenissei and Uss rivers.

The great map of Southern Siberia and adjacent tracts of the Chinese Empire (scale 40 versts to the inch) compiled and edited by Schwarz (1863) was based — concerning the Upper Yenissei area — partly on the map of Klaproth, partly on the mentioned military map and partly by using the itinerary measurements of Schwarz and Kryshin (the itinerary maps were made on the scale 5 versts to the inch). The course of the head waters of Yenissei were copied from Klaproth's map.

An important advancement in Siberian cartography marked the issue of the two orographical maps of P. Krapotkin (1875). The first comprises the southern half of the Eastern Siberia and expresses the main orographical features in a somewhat schematized manner. The scale is 1: 6,720,000. The upper Yenissei area is also included in the map. The second map is a hypsometrical compilation of all data published, on the whole Upper Yenissei area including also the Kan river system. Only the Huakhem and the upper course of Beikhem and Kemtchik are not drawn on the map. The hydrographical features are copied from the map of SCHWARZ. On KRAPOTKIN'S map the crossgoing character of the Yenissei gorge is clearly expressed the first time. Also the shape of the West Sayans appears here for the first time in the orographical picture. The scale is 1: 1,680,000 (40 versts to the inch). On the map there are 6 different hypsometrical steps of 1,000—2,000 feet æquidistance.

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[1] Sven Hedin; Southern Tibet. Discoveries in former times compared with my own researches in 1906—1908. Vol. III. Transhimalaya. Stockholm, 1917. Page 34.

During POTANIN'S Mongolian expedition in the years 1866—1877 the military topographer RAFAILOFF made itinerary measurements, serving as base for the construction of a general map of Northwestern Mongolia (in the scale 50 versts to the inch). The map comprises also the uppermost Yenissei area (Huakhem, Ulukhem, Kemtchik and the lower course of Beikhem). The expedition of POTANIN—RAFAILOFF did not visit the Uriankhai basin, the nearest point to this area being at a route WSW from the S end of Kossogól. Many details in the part comprising the E slopes of the Seylikhem mountains are the result of the boundary- measurements, carried out in the year 1869 by the topographers of the Boundary Commission. (N:most point Shabin Dabán in the West Sayans). An itinerary map from the Karaul Dsindsilik over Tangnu-Ūla to Ulukhem and the Uss river, drawn by MATUSOFFSKY, served as complementary material to SCHWARZ' map.

Another map of Northwestern Mongolia was published together with tome III of POTANIN'S report (1883). It was also this time edited by RAFAILOFF (the same scale as the former one). Concerning the upper Yenissei area considerable corrections due to the use of the itinerary measurements in the Uriankhai country were made by the topographer ORLOFF (1883).

By order of the Imp. Russian Geographical Society the great Siberian levelling along the Transsiberian post-road was carried on in the years 1875—76. In the year 1887 the Russian General Staff published the first edition of the »Asiatic Russian southern boundary map» (Карта ю. пограничной полосы Азіатской Россій) in the scale 1: 1,680,000 (40 versts to the inch), comprising as is known, also a great part of Central Asia. The map has several times been revised. The last edition was issued in the year 1916.

During his travels KRYLOFF also made itinerary maps, though of a quite schematized kind. Their scale is 1: 168,000. They comprise the following routes:

1. Tapsá — Beikhem (zaimka SAFIANOVA).
2. The upper course of Khamsará and Azass.
3. The upper course of Y-suk.
4. The upper course of Sistikhem.

KRYLOFF has also published two cross-sections through Uriankhai in the scale 25 versts to the inch.

Travelling through the upper Yenissei country GRANÖ made quite detailed measurements, serving as base for still unpublished itinerary maps.

The Government Mining office in Minussinsk has compiled a general map of the Uriankhai area in the scale 1: 24,000. This map was used by the Finnish expeditions as orientation chart.

Side by side with the geological reconnaissances in the southern part of the Yenisseisk Government, a topographical mapping of the steppe and the slopes of Kusnetzky Alatau and the West Sayans was carried out. This mapping has made but little progress. The scale of the sheets issued is 1: 84,000 (2 versts = 1 inch).

An important contribution to the more exact measurement of the Uriankhai area is offered by the hydrographical atlas of the upper Yenissei and its tributaries, edited in folios by the Ministry of Communications of Russia on the scale 1: 10,000. The leader of the party carrying out this great work was, as said, W. M. RODEVITCH. He published also a new edition of the general map of the area (on the scale 40 versts to the inch)[1] with all the corrections obtained by this work (1912). This map is also the best hitherto existing. It has therefore served as base for the construction of the map of Uriankhai compiled by the editor, from the results of the measurements by the Finnish expeditions and issued with a second paper.

Somewhat later — during the time of the Great War — the brothers YERMOLAIEFF surveyed as said, an area of the Kemtchik basin comprising 20,000 square versts. The results of their measurements were a map of the basin on the scale 5 versts to the inch.

The Colonization office in Bielotzarsk started a general mapping of the Uriankhai area. The work was soon, however, checked in consequence of the civil wars.

In later years the detailed mapping of the Altai Mountains, carried out by the Russian Staff, progressed to the Mongolian side of the main divide, reaching also the W end of Tangnu-Ūla and the Ubsa-nūr lake. The scale of this hypsometrical map is 5 versts = 1 inch. This work has also ceased in consequence of the political disturbances.

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[1] Original kept at the Ministry of Communications in Russia.

The measurements of the Finnish expeditions, carried out in the year 1917 by BACKLUND, BRENNER, FOSLIE and in the following year by the writer alone, are all of itinerary character.

They consist of three sheets:

I. A topographic sketch map with isohypses (partly hypothetical) comprising the N slopes of Tangnu-Ūla between Shurmak and the Eleges Pass (BACKLUND and HAUSEN).

II. A closed hypsometric route map, comprising the N tributaries of Huakhem from Shuy to Ust Shishkit (BACKLUND).

III. A hypsometric route map extending across the S tributaries of Huakhem between Bilbei and Terinūr (FOSLIE).

V. Geological Observations from Itineraries.

A. The West Sayans.

1) Route: Minussinsk—Yermakoffskoie—Grigorieffka—Bolshoy Oisky Pereval—Buibá—the Uss river—Idshim—Smolina—Turán (BACKLUND, SEDERHOLM, HAUSEN).

The high road from Minussinsk (245 m ab. the sea) SE:ward to the great village Yermakoffskoie, situated not far from the N foot of the West Sayans, runs the whole distance over a broadly undulating steppe, where the rocks are concealed everywhere beneath the black fertile soil, called »tshernosiom». Along the borders of the running waters (right tributaries of Yenissei) there are, however, sections through the underlying rock-basement. The best ones are exposed along a little stream between Lugaffskoie and Oia, where S:ward gentle dipping Devonian strata occur (Backlund). Along the right side of the Oia river, at the ferry crossing, there is another section through the same strata (Devonian sandstones) showing a N:ward dip.

The village of Kazantzevo lies on a flood plain (257 m) at the same river.

In the steppe there are some depressions without outflow. The best known is the rather deep basin occupied by the salt lake Tagarskoie osero, ab. 15 versts from Minussinsk. The salinity derives apparently from the underlying salt-bearing Devonian strata It may be assumed, that the depression has originated by an outwash by the subterranean waters of some salt layers.

The river action has accumulated along the streams great quantities of sand-alluvium, derived from the sandstone layers of the bedrock. The winds of the steppe have here often formed extensive dunes of still drifting sand.

From Kazantzevo the road goes across partly wooded steppes to Yermakoffskoie (289 m), situated in a hilly landscape, where all the hills consist of flat or nearly horizontal sandstone strata. The sandstone is generally of a grey colour.

From Yermakoffskoie the road runs over an already more accentuated steppe-relief to the village Grigorieffka (294 m) situated ESE from the former and on the Malyi Kebesh river (right tributary to the Oia river). The hills and ridges are here of quite considerable height, and the water in the river flows rapidly. The rock in the vicinity of the village consists of sandstone.

Grigorieffka is the starting point of the lately built carriage road leading over the West Sayans to the Russian colony at the lower part of the Uss river. This is also the only way to Uriankhai, because the continuation of the Uss road into this country is a natural track over an even steppe ground.

When following this road from Grigorieffka the first outcrops of old crystalline rocks are observed 7 versts from the village being here of a reddish, quite basic granite. The locality lies on a long marked ridge, separated from the foot of the Sayans by a broad flat valley. The ridge may probably be considered as a frontal tectonical ribbon to the great horst elevation in the south, which is as well the southern limit of the Minussinsk basin.

Where the road approaches the foot of the mountains (23 versts from Grig), and enters the narrow valley of the upper Malyi Kebesh river, the first rock exposures consist of phyllite, steeply dipping and running E—W. The rock shows an alteration between quartziferous and Ca Mg — rich layers (BACKLUND). A greenish, glittering chlorite-bearing variety is quite usual (BACKLUND). The strike is here in some parts N 60° E and the inclination 30°—90°. Eruptive dikes are not visible here. Further up the slopes the occurrence of several concordant sills of greenstones (sp. n. c.)[1], partly transformed into a chlorite schist are noticed, however.

In the distance between 27 and 32 versts from Grig. the road runs across the trend of the schist structure. Only phyllitic schists of various aspects appear.

32 versts from Grig. the road turns suddenly toward SW and follows a left side-valley to Kebesh upward. The phyllitic schist here is completely replaced by a chloritic schist. When approaching the post station Sobatshya Retshka (37 versts from Grig.) the schist gets more folded in detail. The rock is filled with quartz lenses and veins. The orientation of the schist structure is here N 80° E. A general dip could not be fixed, due to the intense folding of the schist mass.

Further up the slopes of the Kulumyssky Hrebet, which the road climbs in great serpentines, there are many outcrops of the schist-rocks, showing partly intercalations of basic eruptives (sp. n. c.). Higher up the extension of these latter gets larger.

On the distance between the Kulumyssky Pereval (1332 m) and the Bolshoy Oisky Pereval (1533 m) the road goes chiefly over a ground, consisting of a chloritic, quartziferous phyllite. Greater masses of quartz appear also in different parts. In some places the bedrock has the aspect of a breccia, due to the great number of quartz veins crossing the rock in all directions (BACKLUND).

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[1] Sp. n. c. = specimen not collected.

The strike of the schists is generally N 80° E, and the dip is always steep. Somewhat to the S of the crest of the Kulumyssky Hrebet there are ruin-shaped ridges, consisting of granite. Granite appears also at the Oia Lake (BACKLUND) (sp. n. c.).

In the Bolshoy Oisky Hrebet the bedrock consists of chlorite-mica schist, running ab. E—W. The dip is steeply N (Olenia Retshka, BACKLUND). The schist is abundantly quartz bearing. The schistosity of the rock is not regular, but rather lenticular.

After passing the Bolshoy Oisky Hrebet the road runs in sharp turns down the southern slopes to the Buibá valley. Along the road a chlorite-mica schist is mostly to be seen. Down in the valley there are a great number of huge granite boulders, evidently an outwashed moraine, originating from some granite massive further up in the same valley (sp. n. c.).

Down the Buibá valley to the station Buibá (101 versts from Grig.) the dominating rock is chlorite schist, often carrying quartz lenses. The strike is here N 60° E, and the dip is steep. In some parts the rock assumes a banded appearance. The schist is often folded in detail.

When approaching Ust Buibá (confluence in the Uss river, 108 versts from Grig.) the valley gets narrower and more gorge-like with rough rocky walls. First there is a typical schist terrane (chlorite schist) without any eruptives. Down the valley granitic(?) partly also aplitic (SEDERHOLM) material is injected into the country rock. The granite(?) is grey in colour and seems to be of a quite basic character. In the lower part of the valley there appears a veritable migmatite. The latter is generally folded and also crumbled in detail. The schist component is mostly black and seems to have been transformed into a biotite-amphibole fels.

From the Ust Buibá down the Uss river the road follows the right side of the latter for a distance of ab. 25 versts. The rock exposed in the steep wall at the roadside to the right is mostly an evengrained grey amphibole diorite (sp. 83, HAUSEN). In some places this rock contains numerous fragments of a banded, skarn bearing rock (sp. 81, HAUSEN), finegrained. The fragments are sometimes so abundant that they form real eruptive breccias in the diorite.

The injection area of Ust Buibá represents probably a deeper geological level as compared with the Sayan schist body just traversed.

The eruptive breccias at the Uss river are crossed by straight dikes of a greyish quartzporphyry with pale red feldspar phenocrysts (sp. 82, Hausen).

Further down the river (ab. 125 versts from Grig.) the steep rock walls disappear suddenly and the valley gets more open. At the same the bedrock changes. The above mentioned diorite is replaced by red sandstones. The limit between the two formations is probably due to a great fault. At this point the road enters the Uss sandstone and porphyry area (a tectonical throw). In this place Backlund observed, that the sandstone strata with a marked unconformity and a basal conglomerate lie on the steeply dipping crystalline schists. Somewhat to the N of the prison camp 126 versts from Grig. the sandstone strata fall ab. 15° S(?) sometimes more steeply (Sederholm). On the opposite side of the river (to the E of the camp) there is a good section through the sandstone formation.

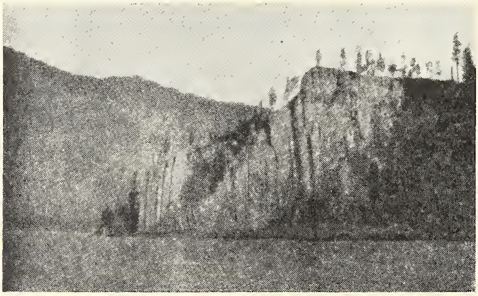

Fig. 7. Steep cliffs of a finegrained brown porphyry with vertical jointing. Uss river, second ferry crossing. West Sayans. Looking downstream.
Photo. Th. Brenner.

S of the mentioned prison camp the river side wall forms a profile, showing unconformity between steeply dipping quartzporphyry tuff and overlying conglomerate beds belonging to the sandstone formation. These latter dip ab. 15° W. (Sederholm). Further down the river the tuff alternates with a greenish felsite, both steeply dipping. Southward (stratigraphically upward) follows a crystalline agglomeratic tuff, containing greater fragments of reddish felsite. More forward in the same direction porphyries seem to alternate with tuffs (Backlund).

Further down the river there are only steep cliffs of quartzporphyry. On the left side this bedrock is capped with a conglomerate layer, indicating that the bottom of the sandstone formation rises in the direction of the stream. The smooth surface forms of the sandstone area have changed to a very accentuated relief, and the valley gets again the shape of a mountain gorge. Where the road crosses the river (ferry) the first time, there are, (135 versts from Grig.) high rock walls of a brownish porphyry (sp. 1, T. s.[1] Foslie, also sp. 80, Hausen) showing a vertical jointing (see fig. 7). The general type here is of fine grain with small feldspar and quartz phenocrysts.

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[1] T. s. = Thin section.

From the SEDERHOLM — collection there are the following specimens:

	N:o	2	Dark violet tuffite in the sandstone formation ..	125	v.fr.	Grig.
T. s.	»	3a	Basal agglomeratic breccia, sandstone formation	128	»	»
	»	3b	Basal agglomerate, sandstone formation........	128	»	»
T. s.	»	4	Quartzporphyry. Boulder in the Uss river......	143	»	»
T. s.	»	5a	Quartzporphyry. Boulder » » »	144	»	»
T. s.	»	5b	Quartzporphyry with idiom. phenocrysts. Boulder	144	»	»
	»	5b	Quartzporphyry with basic incl. Boulder	144	»	»
	»	5c	Darker var. of the quartzporphyry. Boulder	144	»	»
	»	5d	Quartzporphyry. Boulder in the Uss river ..	144	»	»
	»	6b	Quartzporphyry. » » » » »	160	»	»
	»	6b	Quartzporphyry with cavities. Boulder in the river	160	»	»
T. s.	»	6c	Quartzporphyry (grey). Boulder in the river	160	»	»
	»	6d	Quartzporphyry-tuff (greenish). Boulder in the river	160	»	»
	»	6e	Agglomeratic quartzporphyry-tuff. Boulder in the river	160	»	»
	»	6f	Felsite w. flow structure. Boulder in the river....	160	»	»
	»	6g	Banded felsite (the same as the previous?). Boulder	160	»	»

Except the three specimens from the sandstone formation (2, 3a, 3b) all the others are collected from boulders in the Uss river bed downward from the first ferry crossing. They show a great variety of the quartzporphyry both in colour and size of the grains. Not one of them has been encountered in bedrock which along the Uss river seems to consist chiefly of the above mentioned brownish finegrained porphyry. All the other varieties have apparently been transported to the bed of the main river from outside localities, down the many small streams, which join the Uss river from both sides.

At the third ferry crossing point (155 versts from Grig.) to the left there are somewhat lower mountains showing a stratification structure. The rock is here a conglomerate lying on sandstone with a crosscurrent bedding. This whole complex is much dissected by faults. On the right side of the Uss river there are high porphyry slopes (BACKLUND).

In a locality below the third ferry crossing there are slopes to the E from the road, consisting of conglomerate and sandstone (sp. 7, SEDERHOLM). The dip is generally 15°—20° SE. To the right (on the right side of the river) there are only high mountains of quartzporphyry without any overlying sandstone layers (SEDERHOLM). The sp. 7 was collected 163 versts from Grig.

167 versts from Grig., some versts to the E from the fork of the Uss- and the Bielotzarsk roads the rock consists of a strongly folded »hälleflinta-schist» (SEDERHOLM) containing a great number of small quartz lenses. The rock strikes N 20° E and falls 70° ESE. The schist is quite strongly folded

and crushed, a feature very distinct from that of the porphyry-tuff series, just passed.

4 versts up the Idshim valley (the Bielotzarsk road) a »quartz phyllite» (Backlund) outcrops on the left hand. The rock is strongly dislocated and runs N 23° E with a dip of 70° ESE, and seems to be an intensely crushed quartzporphyry with gliding planes. It seems to be the same rock observed by Sederholm (see above).

In the vicinity of Turanskoie Zimovió (179 versts from Gr.) a mountain ridge rises to the NE of the Idshim valley, where a rock very similar to the above described occurs. It shows a gradual transition into a phyllitic rock, which runs N 33° E (one jointplane of the schist falls 20° SW. Backlund).

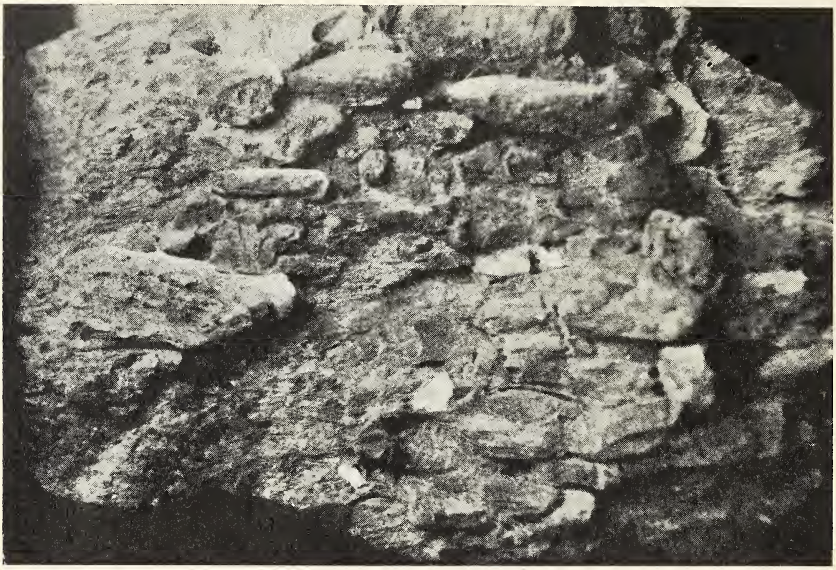

Fig. 8. Pressed conglomerate. E foot of Turansky Tasküll (W side of Turanskaya stepp). *Coll. Sederholm.*

A few versts to the E of the »Maralnik»[1] Putintzeva (in the Idshim valley) there are hills consisting of a »quartzitic schist» (sp. n. c.) with a NE strike. Further to the E phyllitic schists occur, generally strongly folded. In the mountain ridge, forming the divide between the Uss basin and the Turanskaya stepp (Turansky Tasküll), there outcrops in the pass at the road »a greenish amphibole bearing schist» (Backlund) running N 50° E and dipping steeply

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[1] Farm raising maral-deers.

SE. This rock contains glassy, dark quartz veins. On both sides of this rock a chlorite-phyllite schist of the usual Sayan type occurs (sp. n. c.) (BACKLUND).

Down the whole slope E:ward to the little farm Smolina there is only a chlorite schist containing numerous quartz veins.

The old way to Uriankhai crosses this ridge somewhat further to the SW, and here the same chlorite schist occurs, striking N 75° E and dipping N:ward (sp. 79, HAUSEN).

1 verst to the E from Smolina, a quite low ridge rises at the edge of the open plain, called Turanskaya stepp, extending further E:ward. The road passes just at its S end. Here is a section showing strongly pressed conglomerate (see the fig. 8). The size of the boulders increases toward the E end of the section (the largest, of the size of a fist). The boulders consist of quartz-porphyry (partly pressed), schist and quartzite. The cement is quite coarse (sp. 8a, SEDERHOLM). The rock is nearly crystalline with mica covered schist planes. It runs N 42° E and falls 80°—85° NW. It seems that this rock runs conformably with the above mentioned chlorite schists in Turansky Tasküll (tectonical conformity?) (BACKLUND).

Turanskaya stepp is an E:ward gradually rising plain, to the N bounded by a relatively low mountain ridge, a forerunner of the West Sayans. In the E part of this plain some hills rise, which consist of a diabase, dissected by numerous fissures containing iron oxyde (sp. 78 diabase and ore, HAUSEN).

2) Earlier Observations from the Uss Area and the Kurtushibinsky Hrebet. (SCHWARZ, KLEMENTZ, KRYLOFF)[1]

a) The route of SCHWARZ over the Kulumyssky Hrebet and the Oia pass, down the Buibá, E from Uss river to the Idshim, down the lower Uss valley to Ust Ussá.

In the upper Malyi Kebesh valley, upward from Verkhny Kebesh (Grigorieffka) a bedrock was encountered consisting of »talc schist», nearly vertically tilted. The boulders in the river are, however, to a greater part granite, side by side with boulders of a quartziferous talc schist.

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[1] Because the observations of the Finnish expeditions are closely connected with the new built Uss-post road, and limited to a narrow strip, it seems convenient to communicate all the data collected by earlier travellers across these mountains, following other ways: SCHWARZ on the east, and KLEMENTZ and KRYLOFF on the west side of the Uss river. The two last named have also crossed the Kurtushibinsky Hrebet.

In the watershed between the sources of the Malyi Kebesh and the Oia river, the so called Kulumyssky Hrebet, the bedrock consists also of a quartziferous talc schist. The inclination is still nearly vertical. The same rock occurs likewise at the sources of Malaya Oia and was found also along the right side of the upper course of Bolshaya Oia. The shores of the Oia lake consist of »amphibole syenite» (sp. 1971, Martianoff Museum shows a biotite granite).

Down the southern slopes to the valley of the Buibá a »talc-schist» was observed on the right side of the stream. The boulders in the Buibá consist also of this rock but there are many others of granite, grano-syenite and pure quartz. In the secondary watershed dividing Buibá from the Uss river, a »green schist» occurs with the strike NNE—SSW and a dip of ab. 80° (direction not communicated).

Somewhat below Ust Buibá the Uss river receives from the right the insignificant Ussinsky Kliutsh. Here a quartziferous »talc schist» occurs, associated with a brick red quartzite. At the mouth of the little steam boulders of brown limestone and sandstone, granite and porphyry were seen. The opposite side of the Uss valley is very steep and high. It consists of horizontally lying brown limestone, regularily alternating with a stratified dirty-yellowish rock. — 5 versts further down the river Schwarz encountered similar rocks. Here the strata do not lie horizontally, but fall 10° (direction not communicated).

Between the two tributaries from the left side, Tikhaya and Koyart, a little creek ends in the Uss valley, where a reddish brown to greenish grey quartzite occurs associated with a reddish brown calciferous sandstone. At the mouth of the Koyart valley there are steep rocks of a reddish brown, dense limestone, partly showing a schistosity.

In the divide between the Koyart valley and the southward following Sharash valley the bedrock consists of a smallgrained »protogine», i. e. granite. In the watershed between the Sharash and the valley next in order, the Omyl, the bedrock seems to be a »dense talciferous schist». The same rock appears also down the mentioned valley. To the E similar schists continue upward in the same valley, sometimes more calciferous (on the right side of the river). In the neighbourhood of the sources of Omyl the high mountains consist of the same rocks, continuing also S:ward in the divide toward the Idshim valley.

On the right side of the upper course of the Idshim valley a brown-bluish quartzite(?) was observed. Down the valley between the mouth of the Oyat creek and the end of the valley (in the Uss valley) follows a quartziferous, dense, greenish talc schist, dipping ab. 70° (direction not communicated). This is no doubt the same rock as from the lower part of the named valley mentioned by Sederholm and Backlund (pages 53—54).

On the opposite side of the Uss valley, where the Idshim valley ends, there are high cliffs consisting of dark brown, partly paler, small grained, also pelitic and calciferous sandstone of Devonian age.

Floating down the Uss river from this locality SCHWARZ observed on the right side, just below the mouth of the Mirskaya (?) creek, hillsides consisting of a stratified, dense limestone, falling SW. Further down the river similar hills occur also on the left side. Still further downward, on the right hand, a »protogine» (granite), followed by talc schist appears. This last mentioned continues as the dominating rock on the same side of the river. The schist seems always to be nearly vertically tilted.

The specimens collected by SCHWARZ are all enumerated in his report (1864) and petrographically characterized by GREWINGK (1864).

b) The observations of KLEMENTZ and KRYLOFF in the Uss area (chiefly according to the paper of SAYTZEFF 1903).

At the »Second Cordón», to the N of the foot of the West Sayans, where a little river joins the Malyi Kebesh, a syenite (»syenite gneiss») occurs, greenish grey in colour and of banded appearance. This rock is perhaps a modification of the »reddish basic granite» encountered 7 versts from Grigorieffka (see page 50).

In the Bolshoy Oisky Pereval KRYLOFF observed a »chloritic gneiss» somewhat foliated.

In the Aradansky Hrebet there is an amphibole granitite, composed of caolinized orthoclase and plagioclase, quartz, mica, amphibole and magnetite (KRYLOFF, SAYTZEFF).

Further to the south, the Mirskoi Hrebet is composed of »chloritic gneiss», containing numerous veins of quartz. Along the little valley Mirskaya KRYLOFF observed a pelitic schist.

Near to the E end of the kettle-shaped expansion of the lower part of the Uss valley, 10 versts from the village Verkhnie Ussinskoie, the foot-hills seem to be composed of a dark, purple coloured conglomerate. The boulders of this rock consist chiefly of quartz. The cement is calciferous. The age of the rock is Devonian. Sandstone of the same age occurs close to the village Verkhnie Ussinskoie showing a similar dark, purplish colour and a slaty appearance. The cement is also here calciferous.

At the mouth of the river Tioplaya (»the Warm river») KLEMENTZ found a porphyrite of a greyish brown colour containing phenocrysts of plagioclase and a holocrystalline groundmass. $^1/_2$ verst below the occurrence of this rock a limestone appears, extending along the Uss river to the mouth of the

Zolotaya. The limestone beds are vertically tilted. They run E—W. The colour of this rock is dark grey. A kind of foliage can be observed.

At the mouth of the Zolotaya (»the Gold river») Klementz encountered on both sides of the valley a chloritiferous gneiss containing quartz bands conformably to the schistosity. The direction of the latter is E—W. The microscopical structure of the rock shows pressure phenomena and resembles the same specimens of gneiss, encountered by Kryloff.

In the Ashpansky Hrebet (a part of the Kurtushibinsky Hrebet) which is the watershed between Zolotaya (Uss drainage) and Serlikh (Ulukhem drainage) Kryloff collected a clayish and siliceous-clayish slate (Mountain Ouksiam 2317 m). When following the little river Serlikh down to Ilikhem (S slope of the Hrebet) he observed that the bedrock is composed chiefly of clayish slate, reddish dark grey in colour.

The collection of Klementz from these localities (Serlikh—Hailyk) shows also an uralite gabbro. According to Saytzeff this rock is very altered (epidote and uralite etc.). The rock shows pressure phenomena and is of a schistose appearance.

By courtesy of Mr Kashantshikoff, Keeper of the Martianoff Museum in Minussinsk, the writer was able to obtain duplicates of many of the specimens kept at this Museum and collected by Klementz and Bogoliubsky. The list of the specimens is as follows:

N:o
1971. Biotite granite. Head of Buibá (Oisky Hrebet).
29. Aplite granite. Usiupp river, 15 versts fr. Uss.
2246. Aplite granite. Head of Makaroffka (SE fr. Uss).
2225. Aplite granite. Usyum (?) river. 10 versts fr. Uss.
2247. Aplite granite. Great boulder at Postnikoff (Uss).
880. Pressed aplite (?). Mirskoy Hrebet (Aradan r.)
2221. Diorite. Usyum (?) river.
T. s. 23. Gabbro, finegrained, altered. Watershed betw. Zolotaya a. Serlikh.
2222. Diabase, coarsegrained. Tioplaya river.
2207. Porphyrite, finegrained. Betw. Uss and entr. to Tioplaya.
2208. Porphyry, finegrained. Betw. Uss and Zaimka Ivanova.
2229. Diabase, dense. R. side of Makaroffka, 5 v. fr. Uss.
2220. Porphyrite, finegrained. Hill at the Uss village.
34. Diabase (aphanite). Left side of the Uss river. 6 v. below the village.
T. s. 2219. Diabase (aphanite). Badannaya gorá. Uss village.
2250. Diabase (aphanite). R. side of Makaroffka. 8 v. fr. Uss.
2218. Diabase (aphanite). R. side of the Uss river.
2212. Porphyrite, finegrained. Betw. Tioplaya and Uss.
2217. Tuffite. Road betw. Uss and Mordoffskaya stepp.
881. Diabase (?) finegrained. Aradansky Hrebet.

2239. Porphyrite, finegrained. Sources of Idshim (Hopin Dabaga).
2227. Serpentine (?). Head of Usium (?).
152. Amphibolite schist. Petropavloffsky priisk. Serlikh.
130. Felsite. Watershed betw. Ortakhem and Tshingá.
24. Felsite. Left side of Zolotaya. Alexandroffsky priisk.
T. s. (Without n:o) Basic schist. Ashpansky Hrebet.
874. Greenish metabasite schist. Aradán river.
876. Pelitic talc schist. Aradán river.
T. s. 893. Pressed talc schist enclosing limestone. Aradán r.
2237. Talc schist. R. side of Idshim below Ipata.
2232. Pressed greenstone. R. side of Makaroffka ab. Poshkiut.
2231. Strongly pressed greenstone (?). Makaroffka.
35. Pressed talc schist. R. side of Uss r. 5 v. ab. Ashpán.
2243. Talc-sericite (?) schist. Habin Dabaga Mt. Kimih lake.
T. s. 2242. Sericite schist (pressed eruptive?). Hasing Dabaga, summit.
207. Pelitic schist. Omyl river.
T. s. 36. Talc-quartzite schist. R. side of Uss river, Ashpansky Porog.
T. s. 1973. Quartzite-mica schist. Head of Buibá.
T. s. 26. Calciferous talc-quartzite schist. L. side of Zolotaya (rock at the mouth).
T. s. 2203. Quartzite-chlorite schist. Ashpansky Hr. W of Zolotaya.
T. s. 2228. Talc schist. R. side of Makaroffka.
T. s. 22. Pelitic schist. L. side of Serlikh, below Taloffka.
866. Phyllite (associated with limestone). Serlikh.
862. Phyllite. Left side of Serlikh.
2211. Marly slate, lying on porphyry. Betw. Mordoffskaya steppe and Tioplaya.
2187. Slaty sandstone (Devonian). 1 verst above the mouth of the Tereshkina.
T. s. 2223. Red sandstone (Devonian). Mouth of the Usium river.
2216. Sandstone (Devonian). Hill at the Uss village.
T. s. 2248. Quartzite (dense). Summit of Ashpán Mt.

3) The Great Gorge from Dshakul to Osnatiennoie (BRENNER, SCHWARZ, BOGOLIUBSKY).

Up to the present time (1922) there are in the litterature no more geological data from this Gorge than the scanty observations and the sporadically collected specimens enumerated by Schwarz (1864). The Finnish Expedition was not able to undertake any special survey here, because the Gorge was passed by float at a time (late autumn), when great dispatch was necessary. In consequence the writer can not complete the data given by Schwarz in

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[1] The specimens of low numbers are collected by Bogoliubsky, those of high numbers by Klementz. The names of the rocks are mostly corrected, although it is a difficult task to determine the right nature of the vere small samples in every case, especially regarding the strongly metamorphosed crystalline schists.

any other way, than by some general observations and by mentioning specimens, collected during occasional landings on the float passage.

Some specimens, kept in the Martianoff Museum in Minussinsk representing duplicates from a collection probably of Bogoliubsky may be added to the list of Schwarz.

a) The upper section of the Great Gorge. (Dshakul—Ust Ussá).

As already described, the Ulukhem crosses from its origin (confluence of the Beikhem and Huakhem) the whole Central Uriankhai steppe, until, after a quite straight course in westerly direction the river turns suddenly into the mountains by way of a typical water gap. The upper part of Ulukhem flows through a quite flat country. When going downstream one observes, that the right side gets still more mountainous, because the spurs of the Sayans approach the river. The slopes opposite the Dshakul steppe are of imposing heights and continue the same aspect into the Gorge. On the left side of the river similar slopes appear also below the mentioned steppe, filling the »peninsula» between Ulukhem and the lowermost course of the Kemtchik river.

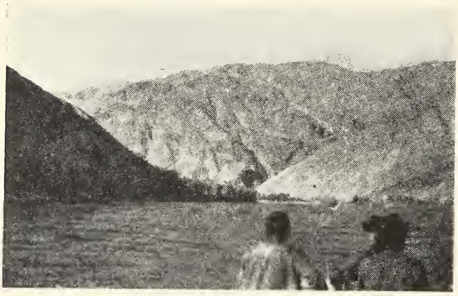


Fig. 9. The Yenissei Gorge at Kemtchik Bom. Looking downstream.
Photo. H. Grönberg

Somewhat below Dshakul the right side of Ulukhem seems to consist of dark quartzite in distinct layers, showing steeply dipping positions. Then follows a mighty series of a dark, pelitic (argillaceous) stratified rock, partly strongly pressed (sp. F 3a, F 3b, T. s., Brenner) alternating with a dense, light coloured quartzite. (F 2a, T. s., Brenner). The tectonic here seems to be more complicated, due to the many folds. The general strike seems to be N 45° E. These rocks continue inward into the Gorge, but when approaching Kemtchik Bom the slopes already change their aspect, the dominant rock here being rather an eruptive (sp. n. c.).

The writer is in possession of a specimen of a quite altered diabase (sp. 400, T. s. Martianoff Museum) from the middle course of the Ku(r)likhem (right tributary to the Ulukhem opposite Dshakul).

From the lowermost course of the Kemtchik river, 15 versts below the farm Biakova and not very distant from Kemtchik Bom, Yermolaieff collected some specimens of rocks, all of a rather semimetamorphic aspect. They are:

T. s. Sp. 20a. Reddish brown, calcif. intensely pigmented pelite.
» 20b. Greenish pelite w. angular quartz grains, argill.
» 20c. Greenish argillaceous pelite.
» 20d. Brownish-violet coloured pelite.

These types belong no doubt to the series of chiefly sedimentary rocks occurring along the lower Ulukhem and classified by the editor as »the Ulukhem series».

Downward from the bend at Kemtchik Bom the Gorge cuts through a chlorite schist mass of an enormous thickness, reaching down to Staroviersky Porog. Here are large outcrops of greenstone with vertical jointing planes.

According to Schwarz (1864) somewhat below Kemtchik Bom there are layers of limestone and chlorite schists in alternation(?) running straight E—W and steeply dipping N:ward. They seem to continue also on the right side of the Gorge.

Somewhat above the mouth of the little stream Yurgún on the right side of the Gorge, a calciferous talc schist has been collected. Just opposite the mouth of this stream to the left there are heavy boulders of a quartzite breccia with a greenish matrix. This rock may perhaps be of a tectonical origin (from the limit between the semi-clastic and the metamorphic schists?). The bedrock consists of a greenish dense, quartziferous talc schist. The same rock occurs also at the mouth of Yurgún. Granite(?) or »protogine» is likewise mentioned from this locality.

From the left side of the river, just above the mouth of Sosnoffka (Malyi Uri?) a greenish grey talc schist has been collected.

Somewhat above Ust Ussá, at the mouth of the insignificant right tributary Listvyanka, Schwarz observed a succession of »greenish talc schist» and layers of marble in alternation. The schist occurs on both sides of the river. Further below, opposite Ust Ussá the left side consists of »talc schist».

b) The middle section of the Great Gorge (Ust Ussá — Bolshoy Porog).

This section has the shape of a veritable canyon and goes chiefly through a lime-phyllitic schist mass, which is in a nearly vertical position. The following data of Schwarz may be communicated:

Just below the mouth of the right tributary Tepsel (the great bend of the Gorge) a greenish talc partly calciferous clayish slate (phyllite?) and even a dense talc schist, occur on both sides of the Gorge.

The narrow shape of this part of the Gorge is evidently due to the predominance of the lime-phyllitic schist mass, often forming vertical cliffs.

c) The lover section of the Great Gorge (Bolshoy Porog — Osnatiennoie)

Below Bolshoy Porog the Gorge gets a more open shape due to the predominance of granitic rocks. Already in the Porog, just below the mouth of the right tributary Kyzyr-Suk, the bedrock has changed into granite (sp. 12, MART. MUSEUM, also T. s.). From the left side of the Gorge, just below the Porog, SCHWARZ collected a smallgrained granite. But further downstream, on the right side, a greenish-grey, clayish slate (phyllite?) occurs, then again replaced by a granite terrane. At the mouth of the left tributary Kurum-suk a basic(?) granite was found, the same rock also on the right side of the Gorge.

Somewhat below the farm Kameshok a dark greenish, somewhat pressed rock has been found. The rock is very finegrained in part, as it is chiefly a clayish(?) substance, but other times grains of quartz are quite abundant, making the impression of a clastic rock intensely crushed (sp. 9 a. 10, T. s., MART. MUSEUM). On the right side of the Gorge, somewhat above the small islets »Kobylie spiny» (»The Mare Backs») a pressed talc schist occurs (acc. to sp. 8, from the MART. MUSEUM).

At the beginning of the »Krutóy Povorót» (»The sharp Bend») just above the mouth of the Seibe-suk SCHWARZ collected a black »clayish slate» (phyllite?) apart from a granite rock of dioritic character(?) Further downstream on the same side (left) a dark greenish, slaty rock occurs, which is a finegrained, quite altered greywacke(?) with angular quartz grains (sp. 7, T. s., MART. MUSEUM). The locality lies below the Malyi Bereozovy Porog. From the same side somewhat above the mouth of Taloffka SCHWARZ collected besides a breccia, »talc schist», running E—W.

7 versts above the mouth of Kantegir, downstream both sides of the Gorge are composed of granite, continuing also below the mouth. The granite is of a somewhat changing aspect showing partly a porphyric structure partly being more basic. Below the mouth of Sosnoffka (right side) a granite with flesh-red feldspar, white quartz and some mica occurs (see sp. 6, T. s., MART. MUSEUM).

Further downstream the granite ceases to dominate and a greenish clayish slate (phyllite?) appears alternating with a »talc schist», the latter containing layers of marble.

On the left side of the Gorge, above the mouth of the Zolotshnaya a light coloured quartzite schist (sp. 5, T. s., MART. MUSEUM) is met with.

The dominant rocks above the mouth of the Golubaya (right tributary) as well as those more upstream, consist of »talc schists» and layers of marble the latter probably of great thickness (sp. 2, MART. MUSEUM). The »talc schists» are often intensely microfolded and quartzbearing (sp. 3, MART. MUSEUM). These specimens were collected at the »Cordon» (not existing here now but at Ust Ussá).

Opposite the mouth of Golubaya a schistose rock of dark greyish colour (sp. 1, T. s., MART. MUSEUM) appears, showing microscopically a fine grain with pressure phenomena. Angular grains of quartz are very abundant; most part of them showing a parallel orientation.

At the end of the Gorge into the Abakanskaya steppe (N foot of the West Sayans where the village Osnatiennoie is situated) the slopes consist of a granite (»protogine»).

In summarizing the geological conditions along the whole Gorge, it may be pointed out, that the uppermost section lies in the semiclastic »Ulukhem series», then follows below Kemtchik Bom an enormous succession of talc or lime-phyllite schists frequently intercalated with limestone layers, the latter often showing the aspect of pure marble. The schists stand vertically and run generally E—W. Below the Bolshoy Porog granites are the dominant rocks, the mountain forms here being less steep than in the talc schist section. In the granite terrane there are, however, often intercalations of schistose rocks, partly »talc schists» with marble, partly dense and dark-coloured, foliated, finegrained rocks, which probably are pelitic sediments. Also layers of quartzite occur. A great schist complex extends with E—W orientation between the granite areas of the lower Kantegir and the village of Osnatiennoie.

The course of the Gorge seems to be controlled by great fissure lines, especially where sudden bends occur. High situated rock terraces were seen in some parts.

4) The West Sayans to the west of the Great Gorge.

a) Route of P. TCHIHATCHEFF (1845)

We can start with T. from the lake Tshulta, lying on the Altaian side of the main divide (the orographical junction between Seylikhem and the West Sayans).

Tshulta, the head lake of the Tshultcha river, leading down to Teletzkoie Ozero, lies in a terrane composed of a black dense clayish slate, abundantly quartziferous. The erratic boulders in the vicinity are, however, mostly composed of granite, derived evidently from the surrounding mountains. Going up a little creek to the watershed against the sources of the Bolshoy Abakán river, T. observed only the same clayish schist. At the named sources the dominant rock is a »greywacke», quartziferous and even containing feldspar, and of a greenish colour. The rock is stratified and often vertically tilted. The strike is NE—SW or E—W.

In the mountains at the main divide (sources of the Kumy river) T. encountered a fine grained granite, showing a transformation into gneiss. Down the W slopes of the divide in the direction of the lakes Dshildis-kul the granite and the gneiss are again replaced by clayish schist and mica schist. The rocks are oriented into the direction N—S. At the outflow of the lakes Dshildis-kul, the Karasuluk, the bedrock consists of a green clayish schist. Further down the Karasuluk a granite terrane dominates enclosing local schist bodies. Then the clayish slate (phyllite?) again appears extending down to the valley of Allash, to which the Karasuluk is a tributary. The stratification of the slate is generally not clearly expressed.

Down the Allash the slate still dominates.

b) Route of D. A. KLEMENTZ (1891): Abakán Iron Works — Tshehán — Karasiube — Aná — B. Anzass — Shamán Tasküll — Kyzass — Khand-syn — Kyzass — Abakán — Matúr — Abakán (downstream) — Tashtüpp.

Starting from the Abakán Iron Works KLEMENTZ crossed the Abakán river and reached the little torrent Tshehán (trib. of Dshebash), which he followed upward. The dominant rock here seems to be a greenish grey clayish slate. Further the route follows a right tributary of the Tshehán, the Karasiube upward (SW:ward) to the watershed between the latter and the Aná river. On the W side of the mentioned watershed the clayish slate is replaced by crystalline limestone, the latter followed to the W by a talc schist. In the Aná valley below the mouth of the Anzass (left tributary) there are steep rocks of gneiss. The Anzass valley lies in a terrane consisting of talc schists. This river was followed upward to the mountain complex Shamán Tasküll, which is the watershed between the Anzass and the Kyzass river systems. The S summit consists of different kinds of clayish slates (schists). From here KLEMENTZ traversed the divide W:ward and reached the Kyzass gold washing works. In the head arms of Kyzass the dominant rocks are clayish slates.

In the Khand-syn Mountains (between Anzass and B. Abakán) the slates are partly replaced by greenstones. The last mentioned seem to dominate in all the upper parts of the Khand-syn range, showing mostly a regular jointing into rectangular blocks. The rock is called »greenstone porphyry» (porphyrite) by KLEMENTZ. Down the Kyzass there are limestones and green schists, further downward followed by a variegated series of limestones. From the mouth of the Kyzass KLEMENTZ travelled down the Abakán river, then he traversed the mountains to the lower course to the Matúr river. This route leads exclusively through a Devonian terrane, where strata of brown-red sandstone alternate with grey and white limestone beds. The topography is here more gently undulating. After some side excursions in the Matúr system, KLEMENTZ reached the mouth of the main stream and from here he travelled by boat down the Abakán.

At Ust Matúr often a red (Devonian) sandstone occurs. When going down the Abakán KLEMENTZ observed large outcrops of greenstones between the mouths of Matúr and Aná. Below the latter at the mouth of the Kirtchenek he noticed outcrops of crystalline limestone. From here he reached the Abakán Iron Works.

c) Geological Observations made by L. YATCHEFFSKY (1909) in the Bolshoy Kyzass gravel-gold-bearing Region.

Devonian strata reach far up the Abakán valley, on the left side forming great cliffs ab. 6 versts above the winter dwelling of the gold washers. The fall of the strata is here 60° NW. On the right side of the valley the same strata reach only one verst upward from the winter dwelling and are soon replaced by cliffs of limestone. These are generally dense or even crystalline (marble) and form a zone of great thickness composing the whole ridge, which divides the lower course of the Kyzass valley from the Abakán valley. Following the Kyzass upward YATCHEFFSKY encountered quartzporphyries (similar to the rocks in the Uss country and Uriankhai). Upward from the porphyry area there follows a breccia, dense and very tough. This is composed of fragments of various sizes and angular forms of a schistose greenish wacke and also of limestone. The cement is psammitic and weathered. The rock has partly undergone strong pressure. At the point, where the right and the left head arms of the Kyzass are united, a complex of slaty and strongly folded limestone appears. The general dip is 80° SW. To the NE from the limestone a greenish breccia immediately follows.

When going up the left head arm of the Kyzass one observes at the mouth of the creek Bezymianka a strongly dynamo-metamorphic diabase, varying only in the size of the grains and the shade of the colour. The rock has a great resemblance to the diabase rocks at the lower course of Kyzass.

In the corner between the left head arm mentioned and the little creek Bezymianka, there appears a coarsegrained »metamorphic schist» alternating with layers of a so called »beresite», a mylonitic rock of nearly aplitic composition, dense and of greyish colour. The general strike is N 70° E and the dip further upward, where only metamorphic schists (»clayish schists») occur, 70° SE. Layers of limestone are intercalated, in parts of great thickness, in other parts as thin sheets, producing even a fine banded appearance. In Bezymianka the strike varies between N 45° and 65° E. The »clayish schist» is partly fine- partly more coarse-lamelled. Further up the same creek the mentioned rock is replaced by a dense, pale greyish or pale greenish quartzitic wacke, composed of small grains of quartz and minute individuals of mica and chlorite.

At the head of the creek in the mountain side there appears in the wacke a black »clayish schist», running N 50° E with a steep NW dip. Above the s chist, in the summit of the head mountain there is again the wacke-rock.

The metamorphic schists crossed by the valley Veseoly run in the direction N 70° E and dip 65°—70° NW.

d) Geological Observations in the Vicinity of the Abakán Iron Works made by Riasanoff (1917) and Hausen.

When going up the Abakán river from the steppe and reaching the village Monók (a cossack-stanitza) one arrives at the edge of a mountain landscape, rising in heights up the river, which leaves here a marked valley and begins its winding course over the steppe. Just to the E of the village there is a steep section through a series of Devonian strata, inclined N:ward. It was observed already by Tchihatcheff (1845). These strata compose a series of hills lying along the edge of the higher mountains, rising S:ward and separated from them by the valley of the little stream Monók. Already the higher mountains consist of old crystalline rocks. The Devonian strata are, however, underlaid by mighty banks of porphyrite, which thus lie immediately over the old rocks.

The old basement, composing also the mountain ridge »Matrós» (crossed on the way to the Iron Works) are metamorphic schists and belong no doubt to the Sayan structure.

When following the river upward from Monók one passes first a section through devonian layers consisting of sandstones and limestone banks. Further upward one enters a mighty series of dark coloured effusive rocks, forming the base of the Devonian series and composing all the mountain sides up to the Iron Works. The dominant types are porphyrites. Their relations to the Sayan schists have not been closely studied but no doubt they are younger. On the Abakán, Riasanoff observed at the base of the Devonian how the effusives in parts are intercalated with the sedimentary strata in the forms of sheets and even tuff-layers. Also dikes of the volcanics cross sometimes the Devonian, indicating that the sedimentation of the basal series was contemporaneous with the volcanic action.

The porphyrites can be followed upward along the Abakán river on both sides for quite a long distance. On the right side the uppermost outcrops are seen in the prominent rock Tchalpán, standing over a river plain and lying to the SW of the Works. When following the left side of the river upward, the porphyrites (sp. A 1, T. s., Hausen) are replaced by an old porphyrite, very weathered (sp. A 2, T. s., HAUSEN) already below the village Abakán. When going along the mountain side to the Plants (lying at the mouth of the Rudnaya Kenia) an area of a pale coloured evengrained granite is entered (sp. A 3, T. s., sp. A 4, HAUSEN). This rock seems to be younger than the old porphyrite (sp. A 2). Just at the Plants there are some interesting profiles in the mountain side to the left of the Rudnaya Kenia, showing a sedimentary contact between limestone of pre-granitic age, and overlying conglomerates and psammites (sp. A 5, t. s., A 6, HAUSEN). The conglomerates contain mostly angular grains of various rocks and minerals, the psammites are also of polymict character with fragments of the old porphyrite. There is no doubt, that these rocks belong to a formation younger than the old porphyrites and the granite, but older than the basal-Devonian porphyrites.

When following the Rudnaya Kenia upward to the iron ore deposits, one observes not only a succession of rather untypical greenstones and their agglomeratic tuffs (sp. A 8, T. s., A 9, A 10, T. s., A 11, A 12, A 15, HAUSEN), but also variolitic types (sp. A 16, HAUSEN). The iron ore bodies, consisting of magnetite of generally high quality (sp. A 18, HAUSEN) lie as vertically tilted lenses in the greenstone masses, these being here of more serpentinized habit. At the limit between the ore and the surrounding rock there is often a transition zone showing (inward) a concentration of the magnetitic constituent.

The ore occurrence shows a remarkable analogy to the magnetite deposits in Tangnu-Ula (Mikhailovsky Kliutsh), described below (see page 104).

The main rock in the surroundings of the iron ore bodies is the greenstone or its derivates. They are mostly schistose and stretched in a NE:ly direction. Lenses and streaks of limestone are often downfaulted in the greenstone mass.

From the Abakán Works the writer rode in SW:ly direction to the gold washing works of TCHERKASSOFF in the Anzass valley, a left tributary of the Aná river. The trail crosses first a watershed between the Abakán valley and the Dshebash, then it follows the latter upward to its sources and crosses another divide between the Dshebash and the Aná rivers, whereafter there is a steep slope to the mentioned river. All this way the rock floor seems to be a greenish psammite of very uniform aspect. Along the Anzass valley upward there are still clastic rocks of similar character mingled with coarser types and even thick conglomeratic layers, showing a prominent tillite-structure with irregularily scattered boulders of various sizes and composition. These rocks often form vertical cliffs along the torrents. No eruptive rocks were seen. It seems beyond doubt that these psammitic and psephitic rocks are of the same kind as the specimens described, occurring at the Abakán Works and lying with a sedimentary contact on the eroded surface of a limestone.

From the descriptions by YATCHEFFSKY, above shortly referred to it seems highly probable, that these rocks are identical with the »quartzitic wackes», occurring in the higher regions of Shamán Tasküll.

It seems to be rather doubtful whether the »greywacke» mentioned from the Seylikem repeatedly by TCHIHATCHEFF (1845) in reality is identical with the Abakán wackes.

B The Central Uriankhai Steppe Area.

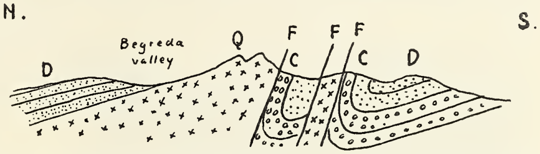
1) Route: Turán—Uyuk—Zaimka LOPATINA—Bielotzarsk.

The village Turán is situated in a flat valley not far from the southern spurs of the Sayan Mountains. The spurs were not visited, but only an isolated hill rising immediately south of the named village. The post road goes on the N side of this hill. The dominant rock here seems to be a dark brown, finegrained porphyritic lava (sp. 77, HAUSEN, sp. 2245, MART. MUSEUM) showing often an inhomogeneous structure. Besides feldspar phenocrysts there are also grains of augite. The rock is intensely disjointed into rhomboid-like pieces. There are also bed-jointings on a large scale. These beds fall W. The whole hill seems to be composed of such beds of lava and also tuffs (BACKLUND). The lava becomes sometimes aphanitic or even blistery.

Opposite the Turán valley (to the E) the mountain slopes consist of the same volcanic rock, as far as could be seen (BACKLUND). — Volcanic agglomerates of a coarse structure occur as well (sp. 9, SEDERHOLM).

Along the S side of the Uyuk valley on the road to Bielotzarsk, there are lava banks, dipping ab. 45° SE, but also S and NE. About 7 versts from Uyuk, along the same road Devonian (?) strata appear, which consist of a grey, stratified sandstone, running N 30° E and dipping 55° SE. Then follows (on the right hand) a brown-red sandstone. Going further along the road one reaches a ridge running N—S. It consists in its lower part of a polymict conglomerate. The boulders are of porphyric granite, quartzporphyry, quartz, slate, andesite(?) and pressed quartzite. Further on there follows a brown-red sandstone again. The dip of these strata is N 15° E (sp. of the conglomerate 10, SEDERHOLM). The position of the sandstone changes then to nearly horizontal, but soon a dip of N 43° W appears. Here the basal conglomerate, containing boulders of granite, porphyry and andesite (Backlund) is again seen.

The northern side of the Begreda valley is composed of reddish Devonian sandstone strata, but the southern side of igneous rocks. This circumstance is manifested already in the topographical forms. In the sandstone terrane there are smooth ridges of insignificant heights, but to the south of the valley real mountain chains and peaks appear. The bedrock consists here mostly of quartz-porphyry tuffs, and of quartz-porphyry, occasionally of granitic development (sp. 11, Sederholm). This complex is evidently the base of the overlying clastic formation, described above, because boulders of the same rocks occur in the basal conglomerate of the latter.



D = Red Devonian sandstone.
Q = quartzporphyry and tuffs.
F = fault line.
C = conglomerate with boulders of quartz-porphyry, dark hornstone, etc.

Fig. 10. A schematic N – S profile through the dislocation zone in the Devonian terrane on the post road between Uyuk and Bielotzarsk. Pass between the Begreda valley and the Kamennyi kliutsh.

Sketch by *H. Backlund.*

The porphyry rocks show a kind of flow structure.

After the passage of the divide between the slopes of the Begreda valley and the deep mountain valley Kamennyi Kliutsh (leading down to Beikhem) steeply dipping conglomerate layes appear, containing the same boulders as in the former localities. Then follows sandstone suddenly cut off by a fault, due to the appearance of a ribbon of quartz-porphyry (see the fig. 10, profile N—S) succeded by a new zone of conglomerate and sandstones. The strike of all the layers and the ribbon is N 75° E and the dip is steep NW. Many of the boulders have been pressed and even broken into fragments (sp. 12a, 12b, Sederholm) at different times.

The profile as a whole shows three inverse fault planes (F, F, F), causing the repeated succession of the clastic strata. These dislocation phenomena are evidently due to a considerable horizontal pression in the table-land structure along a belt running N 75° E, a quite unusual phenomenon in the South Siberian tertiary tectonics.

At the farm Lopatina, situated immediately at the right side of the lower Beikhem 15 versts from Bielotzarsk, there appears a flat lying formation of greyish sandstones, containing coal seams. In the river profiles there is a greyish sandstone, partly very coarse grained and bedded, in other parts more slaty and of a more yellowish colour. At the river's edge there appears a coal seam. Just above it, in the slaty sandstone, prints of plant remains occur. Down the river, on the same side, another coal seam is seen in the river profile, attaining a thickness of ab. 1,20 m. The hanging rock in this place is a coarsegrained sandstone with undulating stratification and with beds of varying thickness (BACKLUND).

From the farm LOPATINA to Bielotzarsk the road follows an old flood plain, limited inland by a quite steep and high bluff of the sandstone tableland formation. In the profiles there are many faults and flexures and even sharp anticlinal bends. The different blocks show varying fall of the strata. The dominant rock is a grey sandstone (sp. with gliding surface, 11, SEDERHOLM).

On the opposite side of the Beikhem river a similar erosion bluff appears. The profiles are here likewise dissected in many ways by faults. This wall is of recent date, forming the immediate edge of the river.

2) Route: Tapsá — Karakhem — Baisút — Huakhem — Bielotzarsk (BACKLUND, BRENNER, FOSLIE, HAUSEN).

The starting point of this route was from the factory SAFIANOVA at the mouth of the Tapsá river on Beikhem. Tapsá was followed upward. At the mouth of this river the tableland formation forms the ground, showing a nearly horizontal position of the strata.[1] Some versts up the river the same strata continue on both sides, on the south side dipping gently SW.

4—5 versts from the factory there appears a conglomerate, dipping 10°—15° SW. It is overlaid by the grey sandstone (the coal bearing) and underlaid by reddish strata, the latter dipping 35° SW, separated thus from the conglomerate by an unconformity. The boulders in the conglomerate consist of sandstone (Devonian?), quartz-porphyry, porphyrite, andesite, black schist and quartz.

Further up the valley at the Tshervy confluence there runs a dike of quartz-porphyry of a dark brown colour. The strike is N 15° W and the total thickness 60 m. The phenocrysts consist of large regular quartz grains and also of magnetite.

c. 14 versts up the valley (from the mouth) the S side consists of quartz-porphyrite of greenish colour. Phenocrysts of quartz are scarce. The rock dips steeply westward and strikes N 15° W. This rock is apparently the basis of the clastic formations described above. The fissure planes producing the orientation of the rock, may be considered as of tectonical origin from a time when the central Uriankhai basin was produced by down-throws.

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[1] Northward from there the tableland formation soon finds its end and is replaced by red Devonian layers, due to upbend. whereafter old crystalline rocks appear (Obs. by the editor).

Here the valley gets considerably narrower. On the way Backlund observed that the quartz-porphyrite is strongly pressed, passing over to a mylonite schist, greenish brown and containing white (secondary) quartz veins crossing the schistosity in a right angle. The topography is here rougher, with sharply formed peaks on the south side of the valley. The schistose quartz-porphyrite (partly tuffitic?) runs nearly straight across the valley. The strike was measured by Foslie to N 60° W and the dip to a very steep one (80° NE acc. to Brenner). Further up the valley there is »phyllitic quartzporphyry», or »quartz-phyllite» according to Brenner. He measured the strike as N 60° W and the dip as 70° SW. A secondary jointing plane falls 30° NW (strike acc. to Backlund N 50° W).

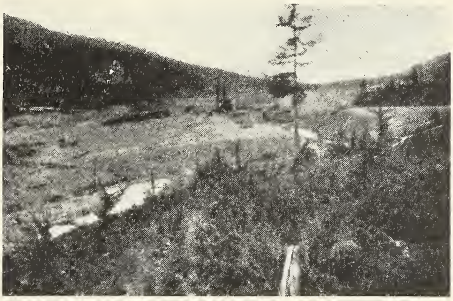

Fig. 11. Dredging in gold bearing gravels. Valley of Karakhem.

Photo. K. Wrede.

C. 30 versts from the mouth of the Tapsá the rock gets massive and gabbroid, middle-grained, extremely saussuritic. There are many pressure cleavages, conformable with the »phyllite» and dipping SW. Further upward there is an alternation between the »phyllite» and the gabbroidal rock, the latter getting more dense and strongly amphibolized. Then follows a saussuritic gabbroidal rock rich in feldspar (anorthosite like) showing partly a kind of breccia structure. This rock is pyritebearing (Backlund).

In the lower part of the Karakhem valley (the gold washing works) the boulders in the river consist of the following kinds of rocks: red granite, grey granite, both coarse grained; finegrained gabbrodiorite; gabbro, partly schistose; aphanitic, middlebasic porphyrites; labradorite with amygdules (calcite and quartz, also zeolites); orthoclase porphyry with felsitic groundmass, partly with streaks, and then without phenocrysts; quartzporphyry, finegrained; tuffs; tuff-breccia; quartz; stratified tuff with phenocrysts, breccias and agglomerates, etc. (Backlund).[1]

On the southern side of the valley, at the works, there is a dense, pale grayish-green rock (sp. 3 T. s., Foslie,). It smells of clay when humid and seems to be very much altered by weathering (thermal action?). BACKLUND considers the rock as a gabbro rich in feldspar and extremely altered. This is the dominant rock along the whole Karakhem valley (a grey, anorthositic gabbrodiorite), and is partly strongly foliated appearing as a veritable slate (»clayish slate»).[1] In the upper course of the mentioned valley a melaphyre and labradorite-porphyrite occurs.

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[1] This great variety of species could perhaps be explained by outwash of some conglomerates of Devonian (?) age.

The strike of schistosity of the altered basic rocks of the gabbro porphyritic series is mostly N 60° W, but variations are common. (other sp. 4,5, T. s., FOSLIE, sp. 1a, 1b, 1c, BRENNER).

At the watershed between the Tapsá and the Baisút rivers the bedrock consists of the same dense grey (mylonitic?) rock as in the gabbro-anorthosite field of Karakhem, but of more effusive kind (BACKLUND). In the valley floor at the Nininsky Priisk (the Baisút valley) BACKLUND collected the following kinds of boulders (the most numerous): pale grey amphibole granitite, quartz-diorite, grey quartz-porphyry, gabbro-anorthosites of the Tapsá-Karakhem types, white quartz, marble, etc. In the valley walls outcrops a pale grey amphibole granitite (sp. 6, T. s., FOSLIE, sp. 2a, BRENNER), jointed without orientation.

Down the Baisut valley to the Nikolaieffsky Priisk the bed rock always consists of granite, which also occurs further downward. Then there appears a smaller area of red (Devonian?) sandstone, apparently a downfaulted part of a once widespread formation. Below this sandstone occurrence a granite terrane again dominates.

The granitite at the Nininsky Priisk is cut across by a dike of a very altered variolite-diabase (sp. 7, T. s., FOSLIE), and also by a more ordinary diabase (sp. 8, T. s., FOSLIE).

Where the Baisùt river ends in Huakhem, the village Feodoroffka is situated (60 versts from Bielotzarsk along Huakhem). In the surroundings there are several hills, composed of eruptive rocks. To the NW from the village there is an amphibolitic anorthosite, somewhat reminding of the Karakhem types. The rock is dissected by several smaller veins of serpentine and even tremolite. There are also dikes of a coarsegrained granite, running ab. N 15° E. To the E the granite outcrops get larger (sp. 11, T. s., FOSLIE) and show a quite inhomogeneous or »migmatitic» aspect. There is also a dike of a very altered finegrained porphyrite (sp. 12, T. s., FOSLIE). The usual amphibolite type occurs e. g. 2 $^1/_2$ versts. N of Feodoroffka (sp. 9, T. s., FOSLIE). The granite cutting through the former has to some degree assimilated basic material. Generally the granite is of the Baisút type.

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[1] It seems to be the mother rock of the iridosmium, forming a considerable percentage of the alluvial gold (BACKLUND).

Down the Huakhem river on its right side, a broad plain of steppe character appears. 10 versts W of Feodoroffka an isolated hill rises from this plain. The rocks composing this elevation are partly a dark, coarse-grained granite (sp. 6a, Brenner), partly a diabase, recalling the dike N of Feodoroffka (sp. 12, Foslie). The diabase contains great inclusions of the granite.

At the locality where the little river Hen Bren joins the Huakhem (further downstream), there are outcrops of diorite (sp. 5, Hausen). In the eruptive terrane lies a remnant of a synclinal-bend of red sandstone layers (Devonian?), resting partly with a basal conglomerate on the diorite. The subjacent rock is red pigmented to a depth of some m (sub-Devonian weathering?) (Brenner).

Between Hen Bren and the Sherbákoffsky Poseólok, settlement 18 versts upstream from the latter, the mountain slopes consist of a dark-grey diorite (sp. 5a, Brenner), dissected by dikes of a red granite (sp. 5c, Brenner), and further of a light coloured granitic modification of the former (sp. 5b, Brenner). In these eruptives there are lenses of a limestone, partly of unmetamorphic habit, partly crystalline. The greatest lens attains a thickness of ab. 20 m. The orientation of the lenses is NW—SE. The contact between the limestone and the eruptives is always very sharp.

3 versts from the settlement (see above) the slopes consist of eruptives, the lower parts being granite of a type recalling the Feodoroffka type, the upper ones consisting of a finegrained amphibolite (sp. 4a, Brenner).

18 versts from Bielotzarsk there is a ferry crossing in the Huakhem river. Just to the N of the crossing point a high mountain slope named Bilana rises over the flood plain. This slope is in reality only the SW continuation of a mountain ridge bordering the river valley to the N (see above).

At the foot of the Bilana there is a platform or tectonical ribbon, consisting of reddish granite (sp. 2, Hausen), quite coarse grained. At the outer edge of the platform a young conglomerate with heavy boulders and a calciferous cement lies on the granite. It forms toward the flood plain a bluff 20 m high. All the boulders consist of limestone, outcropping in the higher parts of the mountain. The conglomerate may be regarded as a subrecent, piedmont-detritic product, in its lower part destroyed by lateral river erosion.

The above mentioned granite is crossed by dikes of a finegrained porphyrite (sp. 1, Hausen). — When going on the platform of granite toward the higher mountain side, one observes that the rock suddenly disappears, and a zone of a felsitic tuffite(?) is met with (sp. 3, T. s., Hausen). It is tectonically downfaulted and strongly pressed between the granite platform and the mountain slope, which consists of a black slaty limestone (sp. 4, T. s., HAUSEN), of a finegrained semimetamorphic habit. The limestone reaches up to the crest of the mountain and is well bedded, as is seen from the accompanying section (see fig. 12).

No doubt, the granite is the oldest of the rocks of Bilana and the limestone considerably younger. The latter reminds one much of the slightly metamorphosed limestone occurrences along Ulukhem (see below) belonging to the »Ulukhem series». The fault lines separating the granite, the felsitic tuffite and the limestone one from another, are oriented in the direction N 60° E. The plane between the felsite and the limestone dips N 40° and conformably with it also the limestone-bed. But going further up the slope one observes, that the position of the banks gets still more horizontal, while at still greater heights a dip to the S appears. The limestone is dissected by numerous dikes of an aphanitic basalt (sp. n. c.), following the structure planes (sill-intrusions). In some parts the basalt gets a more doleritic habit.

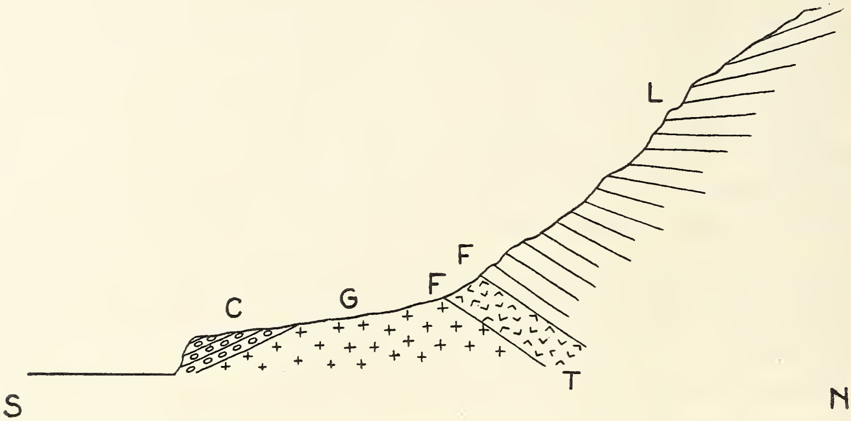

Fig. 12. A N-S schematized section through the S slope of the Bilana Mountain on the right side of the Huakhem river, at the ferry crossing 18 versts from Bielotzarsk. C: young, slightly inclined conglomerate. G: granite, red, coarse grained. T: tuffite, brownish. L: black, platty limestone. FF: faults.

Sketched by *H. Hausen*.

The limestone slopes and the granite platform in front seem to continue quite far to the NE. Also the felsite ribbon is visible for a long distance as a zone of reddish colour along the mountain sides.

Downstream from the ferry crossing, the right side of Huakhem soon gets lower, the limestone ridges being replaced by sedimentary layers, at the beginning of reddish colour (Devonian?) and dipping c. 45° SE, then of greyish colours and in flat lying positions (the coal-bearing table-land formation). On the left side of the valley there is for a long distance a lower (30 m) bluft or slope of the same flat lying strata. Steep sections have been formed, where the swings of the Huakhem at some time have reached the slope.

It still remains unproved, how far upstream the table-land formation follows the left side of the river.

The land corner between the confluence of Beikhem and Huakhem is exclusively composed of the table-land formation, extending northward, as we have seen, at least to the mouth of Tapsá and eastward to the vicinity of Bilana. The limits in these directions are apparently determined by faults or upbends. In the profiles of the land corner there are also many faults causing tiltings and flexures of the different blocks (see the fig. 13). Near to the outermost point of this penninsula, on the Beikhem side, there is a series of thinner coal seams in the strata, the greatest attaining 70 cm in thickness. Also numerous impressions of plant remains occur in the layers immediately above and below the seams.[1] The sandstone is often finegrained and shows on transverse surfaces a fine-banded and torrential stratification. This kind of rock was apparently deposited in calmly flowing water (sp. by HAUSEN). Also cross-current bedding occurs.

3) The Ulukhem River Valley downward from Bielotzarsk to the upper Entrance of the Great Gorge (HAUSEN).

Ulukhem- the Uriankhai-part of the real Yenissei (below the junction of the twin rivers Beikhem and Huakhem), flows, as has been pointed out, to the greatest part of its length through a steppe terrane, where the land forms are rather hilly than mountainous. Only on the right side of the river, below the mouth of the Eleges the slopes grow higher, representing spurs of the West Sayan Mountains. On the whole length of the river section in question there are many excellent cuts through the geological structure, not only in the immediate vicinity of the stream, but also in the numerous tributary valleys and creeks. The fact that the river cuts through the table-land formation as well as through the spurs of the Sayan structure, offers an opportunity to study the mutual relation between these two elements.

Below the river confluence, opposite Bielotzarsk, there appears a longer bluff, showing the greyish sandstone formation in flat lying positions. The bluff is forelaid by a broad, gravel covered plain. A similar plain occurs also on the left side, where Bielotzarsk is situated. Inland from the river, there rises a higher plain, leading up to the undulating steppe of Central Uriankhai.

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[1] A collection of plant remains from here was lost.

When following the right side of the river downstream along the profile of the outcropping, flat lying greyish sandstones, one reaches the mouth of the Irbek valley (right tributary). In this direction the sandstone bluff gets lower, ending in a broad delta plain at the mouth of the valley. N:ward from Ulukhem between Bielotzarsk and Irbek an undulating steppe extends, with more accentuated topography still farther N:ward.

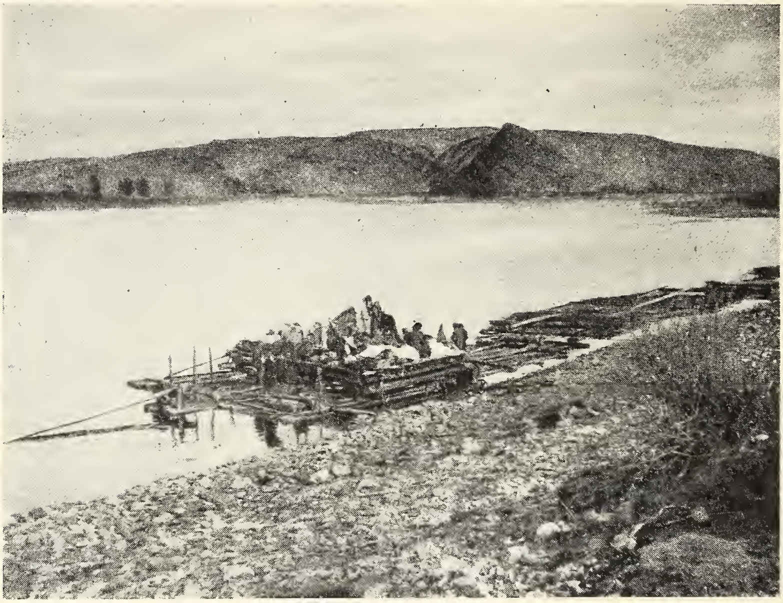

Fig. 13. Confluence of the Beikhem and Huakhem rivers: the beginning of the river Ulukhem. Looking upstream from the beach at Bielotzarsk. Disturbed table-land strata in the background.

Photo. Th. Brenner.

The Irbek valley offers a good opportunity to see a N—S cut through the table land formation as well as a defined dislocation zone in the same (the same kind of dislocations studied in the profile Begredá — Kamennyi Kliutsh farther NE:ward). When going up the valley from Ulukhem, there are the following conditions: The lower part of the valley shows profiles through the flat lying sandstone strata of greyish-brown colours. Conglomerate beds are intercalated. Further N:ward there is a dip S:ward with increasing fall in the same direction. To the N of the Soyot-uluss Kaia-Tash the isoclinal dip changes suddenly into a N:ly dip, forming a great anticlinal bend (see the fig. 14 sketched by SEDERHOLM). Further N:ward the dip gets still more steep or even vertical, but further in the same direction a S:fall again appears (on the right side).

Following the eastern wall of the valley one observes that the isoclinally dipping series of sandstone strata upward (N:ward) change into more psephitic rocks and finally there are mighty banks of conglomerates. These are of clearly fluvial character and intraformational. The general strike is c. N 60° E and the dip 30° NW. Whether an anticlinal upbend occurs here as well has not been observed. The pebbles of the conglomerate are rounded and mostly of smaller sizes. They consist of red and grey quartzporphyry, brickred feldspar, milk white quartz and a black hornstone. The two last mentioned seem to occur in great abundance, assigning to the rock a speckled appearance (sp. coll. 1917, HAUSEN). The cementation of the components is firm. Below this rock there follows sandstone, interstratified with clayish coal- bearing slate. This is again underlaid by sandstone. The coal is allochthonous and mingled with sandy matter. The dip of the seam sis 20° SE. The thickest of them attains, according to SEDERHOLM, 9 m in thickness. On both sides of it there are several thinner ones interstratified with the sandstone and a clayish shale.

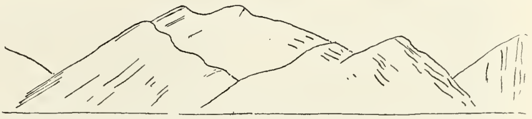

Fig 14. An anticlinal upbend of the coal bearing sandstone formation on the right side of the Irbek valley (right tributary to Ulukhem), just above the Soyot-uluss Kaia Tash Looking west.

After a sketch made by *Sederholm*.

The coal occurrence is situated in the bottom of the Irbek valley W of the little farm Ikki-Otuk. It was visited already a long time ago by ADRIANOFF (1886), who collected here several plant remains (determined by SCHMALHAUSEN, l. c.) occurring in clayish shale.

When following the valley N:ward from the coal seams one observes that the underlying grey (?) sandstones change into red strata of a sandy and marly appearance. They seem to represent the base of the Irbek profile.

The strongly disturbed position of the strata in the described section has also caused a well marked difference in the surface forms compared with those prevailing in the table-land. In the zone where the anticlinal upbends (?) and the steep falls of the strata occur, there are mountain ridges (the Irbek Mountains), continuing with somewhat reduced heights to the NE. The Irbek valley has an epigenetic, cross-going character.

Opposite the mouth of Irbek the left side of the Ulukhem is formed as a vertical erosion cliff, showing the sandstone formation in an anticlinal upbend.

In the profile several coal seams appear, the greatest of them being c. 1 m in thickness. The coal is of the same meagre kind as in the Irbek valley.

Downward from the mouth of Irbek on the right side of Ulukhem the table-land rises to greater heights. Firstly there are some NE:ward tilted blocks, then a large domeshaped upbend follows cut across by the erosion of Ulukhem. In the midst of the river profile the strata fall toward the river, although the observer on the river gets an impression of a nearly horizontal position (see the fig. 15). The erosion bluff is some ten meters high.

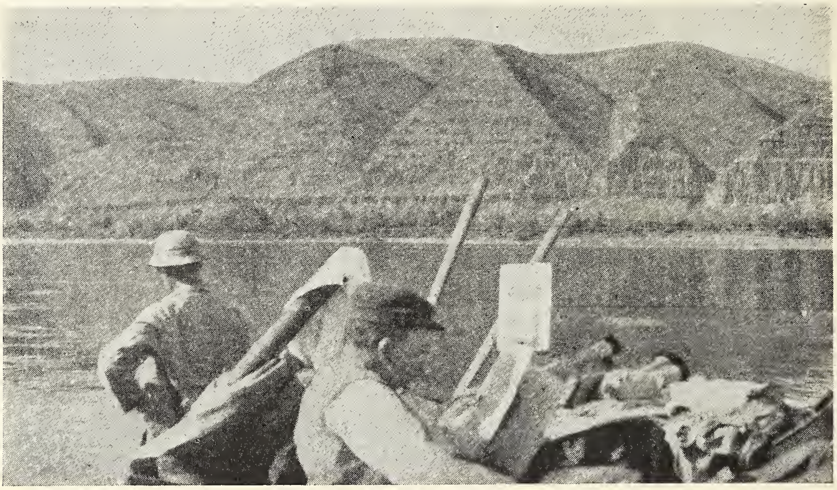

Fig. 15. An erosion cut through the sandstone formation (the table-land) on the right side of Ulukhem. Picture taken from the midst of the river, opposite the Zaimka GUBANOVA, lying at Ust Eleges. Looking N.

Photo. St. Foslie.

The lowermost course of Eleges crosses (downward from Atamanoffka) the table-land formation, offering many opportunities for the study of the stratigraphy.

At the mouth of the river there rises (on the left side) a hill of the sandstone formation with steep cliffs towards Ulukhem and Eleges. The layers fall gently to the S and SW. Smaller coal seams occur. From this or a near lying locality plant remains have been collected (ADRIANOFF 1886, SMIRNOFF 1912). The age of the formation has recently been fixed as Ursa (SMIRNOFF l. c.). It is evident, that the series at Ust Eleges corresponds to the succession of strata on the opposite side of Ulukhem. Perhaps the S:ward dipping strata on the S side are only the S part of a great dôme, dissected by Ulukhem (see above).

When going up the Eleges valley one observes that the valley profile soon gets broader with a flood plain. On the right side a table formed mountain shows horizontally lying strata of the same sandstones. Further up the river, on the same side there are coal seams in the sections. Still upward the topography gets more flat with the aspect of a rolling prairie, but nearer to Atamanoffka the hills grow higher. The flood plain is always of a considerable breadth, and Eleges flows through it in a meandering course.

On the left side of the valley somewhat below Atamanoffka there is a great anticlinal upbend of the table-land formation. In the N flank the strata dip 20° N, in the S flank 45° S. Further upward a new bend with N dip appears, and at the end of the profile (opposite Atamanoffka) a reddish felsitic tuffite (?) forms the base (sp. 3, T. s., YERMOLAIEFF).

At the mouth of the little river Metchegey, on the right side of Eleges, there is a bluff in a flat lying coal bearing sandstone which is grey in colour and well bedded. Interstratifications of conglomerate beds are to be seen. The dip of the layers is gently E. In a fresh river-erosion profile a greater number of thinner seams of coal occur. The quality is very low (sandy, allochthonous). The bedding planes of the sandstones carry abundant prints of plant remains.

The general profile along Eleges between Atamanoffka and Ust Eleges shows a remarkably simple tectonic, the whole formation lying here in a nearly undisturbed position, except the bend on the left side of the river below Atamanoffka. This bend is evidently due to the proximity of the N edge of Tangnu-Ūla, separated from it by a gravel plain (sunk area).

Now we may return to Ulukhem and follow its S side downward. The next bluff on the road, the Hairán Mountain shows a SE inclination of the sandstone formation. Then there follows a greater table-block with steep sides to the N and W. The inclination of the strata here is SE. Nearly the whole mountain consists of the grey sandstones, except the base of the W and NW slopes, where red coloured layers appear (Devonian?). When looking to the N from this locality, we find, that there is a continuation on the N side of Ulukhem of the W slope just mentioned, in the form of a conspicuos cuesta, a long escarpment of the table-land, which here finds its end. At the base of this cuesta red layers also appear. Farther away from Ulukhem the cuesta seems to turn westward, thus forming an amphitheater-like bend.

That the table-land with a relatively more uplifted position really ends at the named cuesta is shown also by the fact, that a basement of older rocks rises on both sides of Ulukhem to the west of the cuesta. The course of Ulukhem traverses thus the cuesta entering the pre-Devonian terrane with a N:ward bend (»Baibulunsky Povorot»). The first ontcrops of older rocks appear at the inner edge of the bend in the form of an isolated hill of cone shaped contours. This hill consists of dark coloured layers, dipping SSE c. 45° and running c. N 75° E. No specimens were here collected but judging from the geological composition of the opposite side of the river (in the strike direction) the main rock members seem to be dark, bedded limestone alternating with basaltic, amygdaloid lava beds.

The red layers at the foot of the cuesta on the S side of Ulukhem also fill a valley floor between the foot and a lower ridge to the NW. This last named (cfr. above) is the first outcrop of the basement on the left side of the river. It consists as mentioned, of a dark limestone, alternating with sills of basaltic lava, finegrained, with scattered smaller amygdulœ (sp. 76, Hausen). Other types are more decidedly variolitic with amygdulœ of chlorite-calcite-quartz (sp. B 1., T. s., Brenner). These rocks are quite altered and calciferous. Also layers of quartzitic sandstone appear. The strike is here N 45°—80° E and the dip is steeply SSE. Although the rocks enumerated are strongly turned up, no pression seems to have altered the rocks, at least judging from the microstructure of the variolitic lava (see above).

There exists thus a great unconformity at the base of the table-land formation. The lowermost layers here are the red coloured ones. In the following pages other localities with a similar unconformity will be described.

When following the left side of Ulukhem downward one can observe that the mentioned upturned structure W:ward passes under a mighty lava-formation, extending over wide areas between Tangnu-Ūla in the S and Ulukhem (below Baibulunsky Povorot) in the N. The lava formation lies over the folded structure with a no less marked unconformity than the table-land-series and may thus be regarded as considerably younger than its basement. The relation to the table-land series cannot be cleared up here (see later). In places near to the lava formation the surface of the old rocks has a remarkably flat aspect, being probably a remnant of a sublava level, recently denuded and thus still conserved from erosion.

The lava formation extends with S:ward dipping beds for at least 30 versts W:ward along Ulukhem. The lateral river erosion has formed a broad terrace plain with a remnant of a somewhat higher terrace-level to the E. Crossing the ridge Ottyg Tash Adrianoff (1886, page 271—272) encountered a conglomerate, very coarse and with even great boulders. In this conglomerate there was found (in one place) a boulder consisting of a light-grey limestone composed exclusively of lower marine fossils. The writer did not see this conglomerate but he is inclined to consider it as a basal formation accidentally conserved, of the table-land formation, lying on the upturned edges of the old structure. Perhaps the lava formation is still younger.

Travelling along the above mentioned terrace down the Ulukhem one can see the reddish lava beds to the left, dipping 45° S. A quite rough topography of lava extends along the border of the river from the farm Safianova downward to Barlyk. Further westward there follows another broad terrace along the same side of the river reaching to the isolated rock-landmark Haerkhan. This plane is bounded in the south, not by the lava, but by a red sandstone formation. The relations between the last mentioned and the lava could not be fixed.

The N side of Ulukhem downstream from »Baibulunsky Povorot» to »Barlyksky Utyos» (-»rock») seems to have a quite complicated tectonic. The writer did not get an occasion to recognize this side above the named »Utyos». But judging from impressions obtained by a study with the field-glass, along the river edge, there seems to be chiefly the pre-Devonian structure, dark coloured rocks. Farther inland, on higher levels, a bright coloured cuesta runs, apparently of the table land formation, being the immediate continuation of the amphitheatre-escarpment at »Baibulunsky Povorot». Between the last named and »Verbliushy Perekát» (»the Camel Crossing») a dark, domeshaped hill rises just at the water's edge. The escarpment bends around this hill, which is a kind of centre. No doubt, the hill is a part of the basement structure, probably lava. Opposite Ottyg-Tash the N side of the river shows a remnant of the sandstone cover. Further downward, opposite the mouth of the little creek Barlyk (dry) the inland-cuesta turns suddenly toward the river again. At this locality the writer was able to study the relations somewhat more closely.

The basement structure outside the cuesta consists of vertically tilted beds of a black, greenish, finegrained sandstone rock (sp. 75, T. s., Hausen). The strike of the beds is E—W. Immediately on the upturned edges of the rocklayers a sandstone formation rests, consisting already at the base of greybrown sandstone beds without any basal conglomerate. Upward in the profile the layers get more brownish or even reddish. Interstratifications of slates and conglomerates are very scarce (sp. 73, Hausen). The fall of the strata is W and NW or even N, depending on the curvature of the cuesta. Nearer to the river side the dip is 20° W.

When standing on the edge of the cuesta one observes a steep mountain edge of dark colours, bordering the sandstone area in the NW. This is evi-

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[1] Also Potanin (1883, page 122) encountered conglomerate when passing the Ottyg Tash.

dently the standing wall of a fault, limiting the sandstone-block in this direction. From the beach of the river the sandstone strata are separated by a terrace plain, except in the lowermost edge, where a vertical erosion profile rises over the waterline. Here the strata dip gently N:ward. Interstratifications of clayish slate (sp. 73, HAUSEN) occur, and also thinner coal seams, in the vicinity of which the bedding planes of the sandstones carry prints of plant remains (sp. 74, HAUSEN). Down the shore the flat lying strata are tilted into a position with dip of 60° E and a strike of N 21° W. Then follow red Devonian (?) layers, dipping 60° NW and running N 55° E (BRENNER). Further down the river there are rough cliffs of old rocks (the standing fault wall), composed of a weathered glassy (?) porphyrite (sp. 2, T. s., BRENNER). Other types are a weathered quartz diabase (sp. 4, T. s., BRENNER) and a (quartz bearing) finegrained hornblende porphyrite (sp. 3, 5, T. sections, BRENNER), all probably of the same origin. Further to the NE in the same mountain wall there are certain kinds of basic eruptives, collected as pebbles in dry torrent beds lead ing down from the same (sp. 71, 72, T. sections, HAUSEN) showing a near petrographical resemblance to the above enumerated. In the dark mass of all these rocks there are, as can be seem already from a great distance, lenses and streaks of bright coloured limestone (altered to dolomite?), stretching far inland to the NE.

On the left side of the river, between Barlyk and Ust Shagonar the isolated rock of Haerkhan rises (see fig. 16) playing a part in the fairy tales of the Soyots. It was visited by POTANIN (1883) in the year 1879 and by ADRIANOFF (1886) 1881. The first traveller observed only (page 121) that the rock consists of »some white specimen forming conic peaks» and that the »colour and outer forms remind one of limestone». The second explorer recognized that the main specimen here in reality is a limestone (page 270). The writer had the occasion to make a slight survey on the steep E side of the rock, where nearly vertical cliffs lead directly into the water. The main specimen in this profile is a pale greyish limestone (sp. 6, T. s., BRENNER) partly of dark grey colour (sp. 67, HAUSEN). It is well banked and shows a strike N 55°—70° E with a fall 40°—65° NW. The limestone seems to be only semimetamorphic, but has been strongly pressed together. In the N part of the mountain the fall is steeply SE. In the main rock there are zones of a greyish brown sandstone (sp. 7, T. s., BRENNER) and also of conglomerate. The last mentioned contains smaller pebbles of quartz, hornstone, jasper, etc. The cement is greenish psammitic. Also streaks of a dark, banded slate occur (sp. 70, HAUSEN). Lenses of sandstone appear in the midst of the limestone, and on the other side masses of limestone lie in the sandstone. These facts bear withness of strong folding movements. Another proof of displacements is a secondary schistosity occurring in the rocks mentioned.

The limestone rock of Haerkhan forms a standing erosion remnant of the pre-Devonian foldstructure which we have followed down Ulukhem from »Baibulunsky Povorot» and which we will discuss later on. The presence of the sub-Devonian unconformity at Haerkhan can also be proved on the S side of the rock, where red Devonian layers in flat lying position come into contact with the upturned edges of the limestone banks.

To the west of Haerkhan a lower ridge of darker colours stretches in westerly direction and seems to be composed chiefly of coarser detritic rocks. (Sp. 7, T. s., BRENNER).

In the sedimentary rocks there are also some smaller igneous intrusives of porphyritic kind (diabase porphyrite, sp. 68, T. s., HAUSEN).

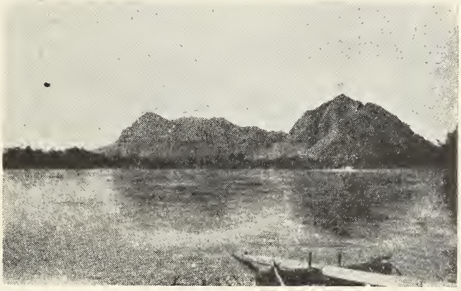
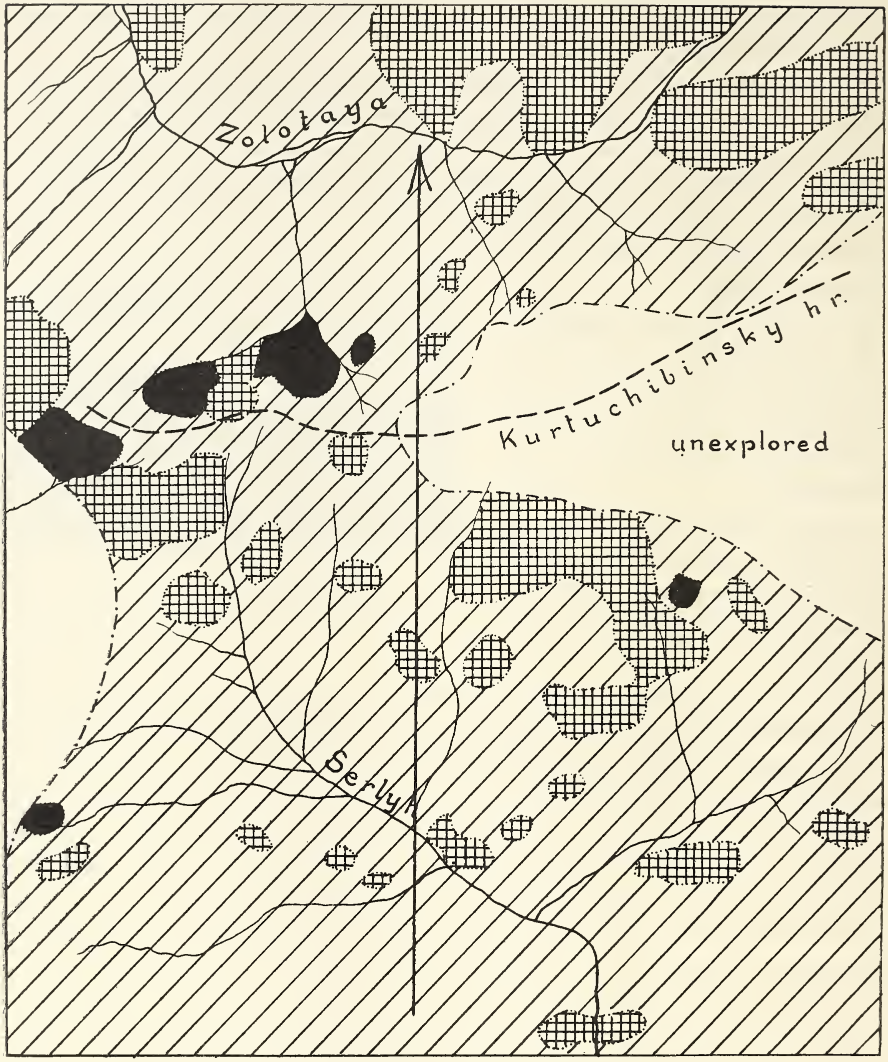


Fig. 16. The limestone rock Haerkhan, an erosion remnant of the Ulukhem fold-structure.
Photo. G. Pehrman.

The N side of Ulukhem is mountainous with a rough erosion topography in the vicinity of Haerkhan. These slopes are really the outliers of the Sayans, or more exactly of the Kurtushibinsky Hrebet. The dominant rocks here are always the dark members of the pre-Devonian structure (sandstones, slates, tuffs etc.) with scattered lenses and streaks of the brightcoloured limestones. Opposite the mouth of the left tributary Shagonar (Ust Shagonar) the mountain Burá rises, which is also well known from the fairy tales of the native inhabitants of the country. It is a great spur of the Sayans and shows a very rugged topography. To the E it is drained by the Temir-suk, to the W by the Serlikh. The writer had not the occasion to visit the mountain, but some earlier data, obtained by special surveys by PORVATOFF (1915) and referring to the upper course of the Serlikh and its head waters, may be mentioned here.

The valleys investigated by PORVATOFF have for a long time been known as gold bearing and the washing business has continued here up to recent times. About the geological conditions nothing has, however, been known, until PORVATOFF made his reconnaissances. According to the little geological sketch map published by him (see the reproduction, fig. 17) the dominant rocks seem to be sedimentary members: limestones, slates, sandstones and conglomerates. They run all ab. NE. In this fold-structure there are smaller and greater mas-



▨ Slates, sandstones and conglomerates (the Ulukhem Series).

▦ Diorites, gabbros, porphyrites and spessartites.

■ Serpentine.

Fig. 17. A part of the Kurtushibinsky Hrebet (sources of Zolotaya and Serlikh).
Scale ab. 4 v. to the inch. After a sketch by *B. Porvatoff.*

sives of igneous rocks: diorites, porphyrites and spessartites, probably of the same origin as the igneous rock mentioned from the »Barlyksky Utyos» (see page 81). These lead also over to more basic members: gabbros and serpentines. On the very crest of the Kurtushibinsky Hrebet (the divide between Serlikh and Zolotaya-Uss) sandstones and conglomerates outcrop.

In this fold-structure there are scattered lenses of limestone, locally of considerable thickness. The boulders in the conglomerates are partly composed of limestone. A greater abundance of limestone is met with in the middle course of the Kulikhem (Kurlikhem), joining Ulukhem opposite Dshakul.

Among the schistrocks the siliceous-clayish slates are the commonest and show greenish-brownish colours. The schistosity planes are silklustrous (sericite) due evidently to a semimetamorphic stage of the rocks. The sandstones of the Taloffka rayon (left head arm of Serlikh) are composed of grains of quartz, plagioclase and epidote. The colour of the rock is generally greyish-green. The conglomerates are composed of crystalline limestones (perhaps the Sayan limestones?), quartz, fragments of sandstones (?) and slates (mica schists?).

Regarding the igneous rocks intruded into the bulk of the sedimentary members, the dominant type is an amphibolite-diorite of somewhat varying acidity Other types are olivine-gabbro and serpentine. In the contact aureoles around these intrusive masses there are quartz veins, which are generally more or less gold bearing.

The writer had the occasion to study the same structure only in the outermost spurs of the Burá Mountain, the so called Obo Hills, rising immediately at the edge of Ulukhem opposite Ust Shagonar.

The Obo Hills are composed of a group of radiating rough-crested ridges, the center being a cone-shaped peak. They consist chiefly of sedimentary rock members: arcose (sp. F 1 a, T. s., 8, Brenner), pelitic sandstone (sp. F 1 b, T. s., 9, Brenner) nearly dense, hornstone like (sp. 62, T. s., Hausen) and platy. The generally pale colours change often to more dark-greyish (sp. 66, Hausen). The somewhat coarser sandstones are often rather quartzitic (sp. F 1 d, 11, T. s., Brenner) with angular grains. Pressure phenomena are microscopically not visible. The coarser sandstones are associated with beds of conglomerates, containing pebbles of red jasper, quartz, granite, etc. (pebble sp. 64, Hausen). The cement is generally a greenish, psammitic mass. Greenish grey slates (sp. 65, Hausen)occur as zones in the psammitic layers, but also red-brown (intensely pigmented) clayish slates in lenses, pressed between the other members (sp. F 1 e, T. s., 12, Brenner). Finally, there is a dark greenish, less slaty, dense rock of pelitic grain (tuff?) (sp. F 1 c, T. s., 10, Brenner). In the Obo Hills no remnants (lenses and streaks) of limestones are seen, but farther to the NE (the strike-direction), in the slopes of the Burá Mountain, several bright coloured spots probably of this rock are visible downfolded in the bulk of the other members. Concordant sills of diabase, middle grained (sp. 63, HAUSEN), are sometimes intercalated between the clastic members of the series.

In order to obtain an idea about the relations of the predevonian »Ulukhem series» to the geological composition of Tangnu—Ūla in these regions we may go S:ward.

The S side of Ulukhem is mostly composed of alluvial plains (the steppes of Shagonar and Dshakul), interrupted by lower mountain ridges, nearer to Ulukhem consisting of the pre-Devonian structure. It may be convenient to follow a transversal section from the S along the little river Arr Tarkholik (right tributary to Shagonar).

The Tarkholik (Arr-Tarkholik) river descends from the main divide of Tangnu-Ūla and runs quite straight N:ward, joining Shagonar some versts above the mouth of the last named. In this connection we may follow Tarkholik only in its lower course, or from a point, where the river leaves its mountain valley and enters the open tract S from Ulukhem.

The N slopes of the mountains, belonging to Tangnu-Ūla consist entirely of sandstone strata. These run NE and have a dip to the SE. The outlines of the crests and ridges are flat and the summits plateau-like. When leaving the mountains (and the mountain-valley section) one observes, that the low ridges, bordering the valley to the E, are composed of igneous rocks and crystalline schists of pre-Cambrian habit. The next ridges to the E show again however, the sandstones, reaching nearly down to Ulukhem. They are probably connected with the sandstone terrane lying to the S of Haerkhan.

On the left side of the Tarkholik valley, N of the higher mountain slopes, there is a series of hills composed of sandstones of reddish colours. All the layers dip SW. The hills have rounded, hat-like forms, a result of weathering of long duration.

Further down the Tarkholik river the hills and ridges on both sides disappear under the vast accumulations, reaching down to Ulukhem (the Shagonar steppe). Between Ust Shagonar and Haerkhan a group of small hills show outcrops of quartzitic sandstones, dipping ab. 10° S. The strata are penetrated by a basic still. The same layers seem to continue to Haerkhan, where, as above mentioned, a ridge extends W from the named mountain. In the latter place the strata run, however, N—S and dip ab. 45° W.

Below the mouth of Ust Shagonar a longer ridge rises or rather a group of ridges, being as said the immediate structural continuation of the Obo Hills. Lenses of limestone manifest their presence by their bright colour.

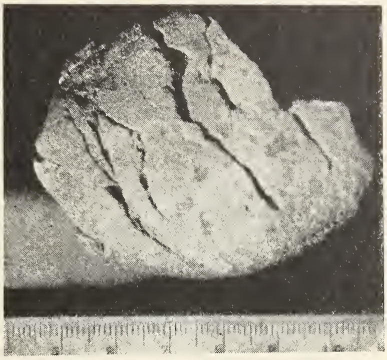


Fig. 18. Pebble from a conglomerate of the folded Ulukhem series, torn to pieces and afterward diagenetized.
Coll. H. Hausen.

All the rock members, strongly folded together, are upturned so as to fall steeply with a general strike of N—S, N 20° E, N 35° E, varying in different parts of the area. At the rives edge the dip is 45° S. A proof of the power of the tectonical disturbances is offered by the conglomerate pebbles being often torn to pieces (sp. 64, HAUSEN, see also the fig. 18). Apart from the folding orientation there is a secondary schistosity, striking N 75° E, or even W—E. The schistosity planes stand vertically. This deformation is apparently of much later date than the foldtectonic and may be regarded as the result of the great tertiary horst movements along the S edge of the West Sayans.

From the highest peak of the Obo Hills there is an excellent view in all directions. The southern slopes of Burá seem to consist chiefly of the darker rock members, while the limestone occurs as limited areas of lenses or bands, standing in haûte relief.

The same structure continues also on the S side of Ulukhem, in the relatively low hills there, which are the real prolongation of the Obo Hills to the SW, separated from the latter by a typical water gap forced by Ulukhem.

The presence of this water gap has caused a local damming up in the fall of the river, and a broad alluvial plain divided into a great number of islets by river arms has been formed above the narrow.

Downward from the mouth of Ilikhem the mountain slopes seem to consist of quartzite, running ab. 45° NE. The slopes are forelaid by great piedmont fans, cut off in their lower part by the lateral erosion of Ulukhem and forming vertical cliffs of considerable heights (see the fig. 19).

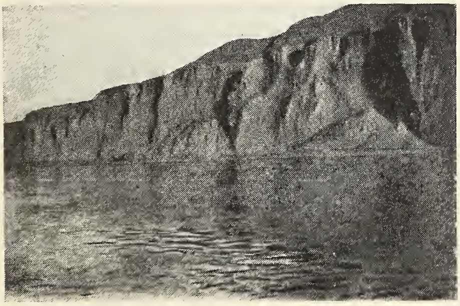


Fig. 19. Erosion bluff at the right side of Ulukhem in the vicinity of Ust Kurlikhem.
Photo. K. Wrede.

At the mouth of the valley of Ku(r)likhem there is a ridge shaped foot hill, apparently a fault ribbon.

4) The Central Uriankhai Steppe between the Bren and Eleges Rivers. Bielotzarsk—Sosnoffka. Ust Bren—Bolshoy Asik—Shimbalsky Hrebet—Sosnoffka—Rybnoie Osero—Zaimka SHELDEMESHEVA — Shurmak—Bren (BACKLUND, HAUSEN, SEDERHOLM).

As mentioned in the chapter on »Physiography» the greater part of the Central Uriankhai steppe to the S of Ulukhem lies outside the drainage to this river. We may thus treat the observations made by crossing routes through this area apart from them, referring to the vicinity of Ulukhem. Besides it may be convenient to describe the geological data along the Shurmak-Bren rivers, the limit of the mentioned steppe in the E.

Passing along the road from Bielotzarsk S:ward to the little Russian village Sosnoffka, situated at the N foot of Tangnu-Ūla, but a few outcrops of the bedrock are found, because nearly the whole surface consists of an even steppe soil grown with grass or — in some parts — covered with drifting sand. The shallow depressions are marshy or occupied by salt lakes (see the »Hydrography»). The flat-rolling relief bear witness of the fact, that the underground is composed of a flat lying formation which, according to the scarce outcrops and the sand masses, may always be of the table-land sandstones. The saltness of the lakes Tuss-kul, Kaden-kul and Dshider-kul a. o. may derive from some salt bearing underlying strata, perhaps Devonian (?).

The rolling prairie does not reach the N foot of Tangnu-Ūla, but is separated from it by a broader, gravel filled valley-like depression, the N edge consisting of an upbend of the table-land strata, which here is red sandstone dipping S. The mountain torrent Turgenkhem, entering the lowland, where the village Sosnoffka is situated, follows on its way further to the W the S foot of the mentioned cuesta, until, by the name of Metchegey, it joins the Eleges river below the village Atamanoffka. This stream receives also all the underground waters descending from the N slopes of Tangnu-Ūla to the W from Sosnoffka (a. o. the water from the torrents Urgailik and Bolshoy Shangán).

Between the cuesta and the foot of Tangnu-Ūla a ridge rises in the midst of the valley bottom. It consists of a greybrown slaty sandstone and runs E—W and falls 29° N, the position being distally dipping in relation to Tangnu-Ūla. In the erosion profiles at Sosnoffka (Turgenkhem) alternating layers of grey and violet marls are seen, the latter in greater abundance. The strike is S 85° W and the dip 44° N, a typical flanc tectonic. Further up the torrent no more profiles are seen, but the first foot ridges of Tangnu-Ūla, lying immediately to the E from the torrent, consist of granite, red, and coarse grained. The rock is dissected by dikes of basic habit (gabbro and diabase). N:ward the granite shows a transition to an arcoselike rock, no doubt a sub-Devonian in situ-weathering-product. The rock has a bedded appearance with a fall to the N and an E—W strike (BACKLUND).

When following the way to the E from Sosnoffka, along the N foot of Tangnu-Ūla, one can observe that the first granite ridge is forelaid by a lower cuesta of sandstone.

Further E:ward over the steppe one arrives at an isolated hill, standing quite abruptly over the smooth surface. It consists of quartzporphyry, tuff and also porphyrite, belonging no doubt to the sub-Devonian effusive series (BACKLUND). The same is evidently lacking at Sosnoffka. To the E of this hill there are greater ridges of quite mature forms. They show dark greyish colours and consist probably of the same porphyry formation. To the S of the road, at the edge of Tangnu-Ūla, there are several lower ridges, probably consisting of Devonian sandstone (judging from the boulders lying on the steppe surface).

Nearer to the freshwater lake Dshagatai-kul or Rybnoie Osero, a rock consisting of grey granite, quite basic and scarcely quartz-bearing outcrops on the left side of the road. This rock is traversed by dikes of aplitic and pegmatitic differentiations.

On the way E:ward from the lake, along the N foot of Tangnu-Ūla there are smaller hills consisting of granite.

To the N of the Madshalyk, the outlet of Dshagatai-kul, there is a somewhat higher rolling steppe, increasing in height to the E. The underlying rocks are here probably mostly the table-land strata, as may be judged from the smooth surface forms. Nearer to the Madshalyk valley bottom there are, however, some rougher hills of granite (?). On the way from Dshagatai-kul to Maximoffka SEDERHOLM found many boulders of granite and also outcrops of the same rock. In one locality to the E of Dshagatai-kul a white-grey, nearly dense porphyry tuff (sp. 20, T. s., SEDERHOLM) was encountered. The rock falls steeply. In a locality lying half way between Dshagatai-kul and Schurmak there is a group of hills consisting of granite (see above). A fine grained, dark diorite (sp. without n:r, SEDERHOLM, date 9/IX, 1917) forms dike-like masses in the granite.

To the N and NE from Maximoffka the hills are composed of red conglomerate layers and sandstone. They dip 15° N. The boulders of the conglomerate consist of sandstone, quartz, a dense dark rock, quartz-porphyry and also finegrained, grey limestone (sp. 22, SEDERHOLM). Further eastward in the direction of Vladimiroffka (at the Shurmak river) the dip gets steeper to the N (judging from a distance).

On the left side of the Shurmak river just N of Vladimiroffka there are hills of red Devonian sandstone, gently dipping to the SW. These strata form the W slopes of a mountain, showing steep cliffs to the E, where Shurmak runs in a water-gap like valley. The higher E part of the mountain consists of a quartz-porphyry, showing a distinct jointing in the form of beds, upward of decreasing thickness. The jointing planes dip 70° SE. The sandstone reaches as a mantle nearly up to the summits. The dip of the strata is 27° SW. At the sedimentary contact the overlying sandstone carries fragments of porphyry.

Around the E side of the mentioned mountain the Shurmak river flows in a great curve, the course being in detail a very meandering one. The valley is filled with an even gravel plain, showing that this water gap may be of a more mature stage.

At the inner side of the confluence of the Shurmak and Bren rivers there is a rough cape, consisting of quartz-porphyry.

Somewhat downstream (Bren valley) there is another mountain spur from W, causing a narrowing of the valley. This cape consists of grey granite. The next following spur shows also granite of greyish colour and dikes (?) of red granite. Further NE:ward along the valley there is again a narrow passage, where in the side spurs the same grey granite appears, in this place containing inclusions of basic rocks. Still farther downstream is a real water gap, formed by mountain spurs on both sides. The main rock here is granodiorite (sp. 8a, BRENNER). The rock is traversed by dikes of finegrained diabase (sp. 7a, BRENNER). Fragments of a dark, also finegrained rock are enclosed in the granodiorite. These are probably a metamorphic product of a clayish (?) sediment (sp. 8 b, BRENNER).

After the water gap there follows a new broadening of the valley with broad terrace plains. The next cape is composed of red granite, belonging no doubt to the same eruptive series as the quartzporphyries of the Huakhem area (see below).

Just above the mouth of the little left tributary Bolshoy Asik there is a second barrier, cut across by the river. The spur on the W side consists of a dark quartzporphyry, showing an intense decay into small angular pieces. Over this rock there rests a sheet of red Devonian sandstone containing a basal conglomerate. The sheet dips NE, toward the river.

After passing the valley mouth of Bolshoy Asik, one climbs another spur, representing a third narrowing of the main valley. It is composed of quartzporphyry, capped by Devonian sandstone. Further down the valley there is a low cape on the left side, consisting of grey granite. Just at the mouth of the Bren in the Huakhem there is a fourth remarkable water gap, cut into a mass of quartz-porphyry (see page 121).

When following the Bolshoy Asik valley upward from its mouth, one observes, that the porphyry rocks at the mouth are soon replaced by abyssal igneous rocks. Outcrops are not seen in the immediate vicinity of the valley, but many loose boulders, lying in the dry torrent beds descending from the slopes in the N and S, show the predominance of granitic rocks in the mature sculptured hill-regions on both sides (see the fig. 20). In the vicinity of the little Buddha chapel standing on a broad terrace plain, the boulders consist of grey granite.

Up to the watershed between Bolshoy Asik and Shimbalsky there is only an even steppe ground without any outcrops. The watershed consists partly of a rather sharp mountain ridge, called Shimbalsky Hrebet. The dominant rocks are skarn-like varieties of partly pseudoporphyric development (sp. 8, T. s., HAUSEN) but also greenish black amphibole-fels (sp. 7, T. s., HAUSEN), intruded by (?) an evengrained gabbrodiorite. The last mentioned is probably associated with the great masses of gabbrodioritic rocks, occurring more to the W, down to the farm Angadzi.

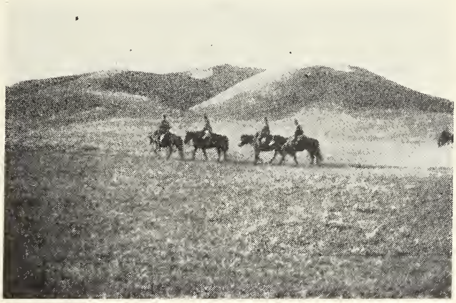


Fig. 20. Mature relief in old eruptives. Bolshoy Asik valley. Central Uriankhai steppe.
Photo. H. Hausen.

When following the watershed S:ward from Shimbalsky Hrebet, one meets with a great mass of crystalline limestone (sp. 9, HAUSEN). The relations of this rock to the above enumerated are not clear, because the steppe soil covers the bedrock nearly everywhere. The limestone is associated with a magnetite occurrence, where also skarnlike products occur (sp. 10 and 11, HAUSEN). Greenstone dikes traverse the limestone. WSW from Shimbalsky Hrebet there extends the dry valley of the same name reaching down to the broad valley Angadzi. The S side of the former valley consists of an undivided mountain ridge, where the dominant rocks are a finegrained greenstone (sp. 61, HAUSEN) and a diorite (sp. 17, T. s., HAUSEN). The former shows often a porphyritic development and encloses smaller and greater masses of limestone (marble). In the N side of the same valley all the hills are composed of an evengrained olivine gabbro (sp. 14, T. s., HAUSEN) and also of a porphyrite of a similar kind as on the S side. In some places also an amphibolite occurs.

The cattle farm of Angadzi lies in a flat bottomed valley running ab. NW, between hilly ridges with barren, somewhat roughly formed summits and gently sloping sides, the whole giving an impression of a mature relief.

Coming from the E, just before reaching the valley of Angadzi a group of barren hills with broad slopes are passed on the right hand. These consist of gabbro-diorite.

From the farm the writer made an excursion N:ward to the so called Dshidersky Hrebet. It forms an arc-shaped wall with the concave side turned to the S. Inside the embayment there lies an isolated hill, composed of limestone. The Hrebet shows a great variety of rocks. The (older) sedimentary members are represented by limestone, partly white and crystalline, partly more dark and apparently less metamorphosed. In contact with eruptives the limestone is altered to skarn of limited extension, however. The eruptives are red granite of purely aplitic type (sp. 21, HAUSEN), a quite finegrained reddish syenite (sp. 20, HAUSEN), dark coloured diorite (sp. n. c.) and a finegrained greenstone (sp. n. c.).

The SW end of this mountain arch has the appearance of a somewhat more isolated group of hills, all composed of a series of rocks, having, as it seems, no relation of genetical kind to the above enumerated specimens. They are all typical tuffite rocks (sp. 22, 23 and 24, thin sections of all, HAUSEN), belonging probably to the sub-Devonian effusive series. The colour of the rocks varies between reddish grey, violet-grey and dark grey. A kind of psedoporphyric development is common. The tuffites are all well bedded and show a steep inclination and a N (?) strike.

The left side of the Angadzi valley (the little stream runs to the NW) is formed by an undivided barren ridge, with great sand masses on the slopes toward the farm. The road from the farm to Sosnoffka leads over the ridge not far from its NW end. To the right from the pass there are some hill-tops, the nearest consisting of grey limestone and limestone-schist, running N 35° E and dipping 56° SW. This tectonic is probably due to tertiary (?) fault movements. The hills in the distance (to the NW) are composed of a vertically tilted schistose, grey porphyry-tuff, being more massive to the W. To the W follow some hills, probably of limestone, judging the colour of the rock surface. No doubt the tuff-rock is of the same kind as the above described tuffites from the SW end of Dshidersky Hrebet.

After passing the ridge, one descends to a wide valley bottom, generally marshy and running ab. NNE. S:ward it reaches to the vicinity of Tangnu-Ūla. N:ward it opens to the shallow depression of the salt lake Dshider-kul.

The ridge with the barren summit hills just crossed, runs S:ward along the broad valley and joins a hilly landscape to the N of Dshagatai-kul (Rybnoie Osero), where a summit of relatively considerable height reaches over the surroundings. The hills are probably composed of granitic rocks (?), further W, however, of porphyry rocks (see the route from Sosnoffka to Dshagatai-kul).

The bottom of the broad valley mentioned above is to the greater part occupied by salt marshes or by dried out ones, the surface being now covered with a salt crust. To the W slowly ascending slopes lead over to a rolling steppe (see the fig. 21), the Central Uriankhai steppe (traversed by the Expedition somewhat more to the W). Outcrops are here very scarce, and on the way to Sosnoffka none were seen. The great masses of drifting sand and dunes over some areas of the higher steppe, show, that the underground may be composed chiefly of sandstones (the coal bearing table-land formation).

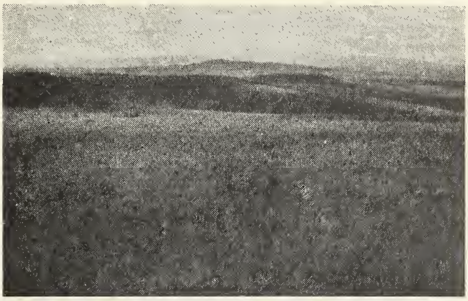


Fig. 21. A outlook over the Central Uriankhai steppe. N from Madshalyk.
Photo. K. Wrede.

The broad valley to the W from Angadzi may thus be a divide between the eastern part of the steppe area, composed of old crystalline rocks and the western part, occupied entirely by the table-land formation. A fringe of Devonian (?) rocks, strongly dislocated runs along the W edge of the area of old crystalline rocks (the limestones and tuffites in the ridges at Angadzi).

C. The Tangnu-Ūla Mountains.

(Between the Khamar Dabán Pass and the Tarkholik Pass).

(Cfr. the itinerary map n:o 1.)

1. The E subsector: Khamar Dabán Pass — Turgenkhem (BRENNER, BACKLUND, SEDERHOLM, HAUSEN).

The Khamar Dabán pass has been used by various explorers, going to or from Mongolia, but no geological data have been communicated from this route.

The Finnish Expeditions have visited the mountain-corner, formed by the sudden bend of the N edge of Tangnu-Ūla to the S, where the upper Shurmak valley extends. Brenner's party descended the valley of Shorbluk, a right tributary to the upper Shurmak, and arrived down to the latter at the farm Skobeieva. Then the party turned N:ward, following Shurmak downstream. The writer made an excursion from the farm Sheldemesheva (lying on Shurmak, somewhat above the confluence of the Madshalyk) upward along the river, and visited the spurs of Tangnu-Ūla here.

Brenner has communicated the occurrence of granite from the Shorbluk valley. Where the last named joins the Shurmak valley, a reddish, coarse-grained granite occurs, containing great inclusions of diabase. Down the latter valley the dominating rock seems to be granite, dissected by aplite dikes. The granite is sometimes replaced by basic rocks (diabase, gabbro). On the surface the granite shows an intense decay.

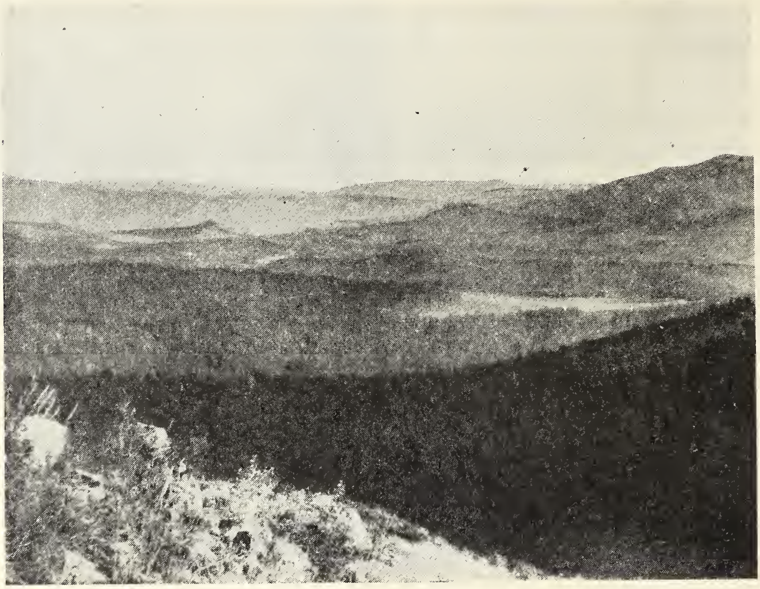


Fig. 22. A view over the upper part of the Shurmak valley toward the Tangnu-Ūla Mountains. Porphyry area in the foreground, old granodiorite in the distance. Looking S.
Photo. Th. Brenner.

3 versts to the SW of the farm Skobeieva, situated at the right side of the Shurmak, Brenner found in the same valley the grey granite, carrying inclusions of diabase. Ab. 2 versts S of the farm a red granite appears, which is of a quartz-porphyry habit. The rock shows a clear transition to a dense quartz-porphyry and tuffite. (sp. coll. Brenner).

When following the left side of the upper Shurmak valley (along the foot of the S:ward bending edge of Tangnu-Ūla) the writer observed that the main rock of the mountain slopes is a grey granodiorite with somewhat changing basicity (even diorite). The eruptives contain numerous inclusions of basic rocks with assimilation transitions to the former. All types of rocks can be studied in the vast piedmont cones radiating from the mouth of every valley in this part of Tangnu-Ūla. At the foot of the high slopes there are in some parts foothills of a sharp-crested shape. They consist of the same grey granodiorite and represent no doubt fault ribbons, originated simultaneously with the great horst movements of Tangnu-Ūla.

The upper Shurmak valley is remarkably flat bottomed, due to an extensive flood plain accumulation of a fine grey silt and sand. These materials are no doubt the weathering products of the easily decaying granodiorite terrane.

The crest line of Tangnu-Ūla in the vicinity of the Khamar Dabán pass is smooth (plateau). According to the reports of earlier travellers there are no serious obstacles to carriage traffic over this pass.

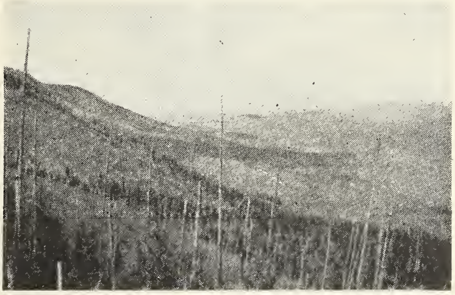


Fig. 23. N slopes of Tangnu-Ūla S from Madshalyk. Note the dryness of the country. Pict. taken to the W.

Photo. H. Hausen.

The little valley Verkhny Seylikhem descending from the slope of Tangnu-Ūla at the locality where the great bend of the mountain foot into S:ly direction occurs, was visited by a party, which collected from there specimens of granite, limestone and finegrained diabase. The following valley to the W, the Nishnyi Seylikhem, is eroded in a bed rock consisting of a pale coloured biotitegranite, containing inclusions of a basic schist. Also an older more basic granodiorite (amphibole bearing) occurs. There are excellent examples of assimilation in the granite of amphibolite with all transition stages. In the torrent bed there are boulders of a reddish, coarsegrained marble.

The next valley to the W (»the Tent-valley»), where Backlund's party and the writer camped, is a longer one. The geological conditions were here studied somewhat closely. The eastern wall of the lower part of the valley consists of granite, grey and well bedded, and marble, of a greater thickness and dissected by dikes of greenstone. The rock is partly faulted and torn. N:ward it alternates with a schistose cordierite-(?) gneiss, penetrated with parallel dikes of amphibolite. The rock runs ab. NE and is soon the dominating one. Further N:ward the amphibolite again replaces the gneissic rock, which occurs as inclusions in the amphibolite. Following the crest of the E wall of the valley (a secondary watershed) to the S, the writer observed that the granodiorite has a wide extension in the said direction. The rock contains numerous inclusions of amphibolite, showing all stages of assimilation with the main rock, a typical phenomenon in the Tangnu-Ūla batholith. In the N end of the western wall of the same valley there is a schistose greenstone, partly strongly folded and containing smaller dikes of granite, partly torn off due to the folding movements. There are also pegmatitic dikes of crossgoing character. A somewhat higher summit further S:ward consists of greenstone (partly chloritic, partly more amphibolitic) and a cordierite-(?) gneis. The latter rock contains often parallel stripes of granitic material. In the chlorite schist types the arterite products are often ptygmatically folded. Besides there are crossgoing dikes of pegmatite. Southward along the crest the granite intrusions get more numerous, enclosing fragments of greenstone. Then there follows (in the same direction) only granodiorite, a darker amphibole bearing type of inconstant basicity. In some places it shows a transition to a gabbroide type with a peculiar inhomogeneous habit (breccia?) (Backlund).

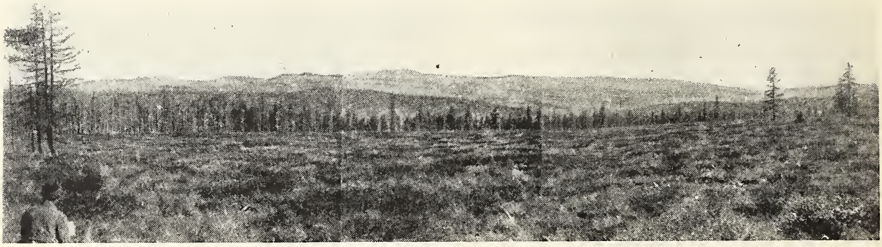


Fig. 24. A S:ward outlook over the main crest of Tangnu-Ūla from a point on the upland surface SE from Dshagatai-kul (Rybnoie Osero). The valley in the distance at the right side is draining to Mongolia. Note the peneplain character of the upland surface.

Photo. H. Backlund.

During a separate excursion from Dshagatai-kul S:ward up to the crest of Tangnu-Ūla the writer made the following observations: The whole N slope of Tangnu-Ūla consists of granite, quite salic and containing very few basic inclusions. In the upper slopes there is only a pale coloured biotite granite, coarse grained. The rock surface is weathered into a sandy decay-product. Over the smooth upland surface there are some standing rocks (weathering-remnants of granite) showing horizontally lying banks. No traces of greenstone rocks or schists were seen except the granodiorite and related rocks.

Apart from the plateau-like upland surface there are deeply cutting valleys, apparently controlled by fault lines. Further morphological observations will, however, not be communicated here, but are treated in a special paper.

The sector of Tangnu-Ūla lying immediately at the SW side of Dshagatai-kul was visited during a climb straight up the slope to the upland plain, and also by an excursion along the Khory valley, the mouth of which lies WSW from the W end of Dshagatai-kul.

When ascending the slope SW from the lake a felsite-like porphyrite is seen. Further upward a schistose, partly tuffitic rock comes in sight. It seems penetrated with a finegrained diorite (?). The schistosity runs S 30° E. On the upland plain there are abundant boulders of all kinds of greenstone from finegrained types to labradorite-porphyrite. Also boulders of granite are represented. Further to the S there are heavy in situ boulders of a fine grained, platy granite (dike-habit). Besides there are boulders of a pale coloured orthoclase porphyry with biotite developed as phenocrysts. Still further S:ward the granite boulders are more numerous. In one boulder there is a greenstone, crossed by a smaller dike of granite, finegrained and micropegmatitic. From here the upland plain slopes slowly to the S, but rises again in the distance. On the right hand there is the deeply cutting valley of Khory (BACKLUND).

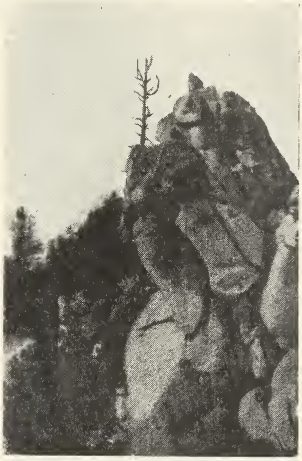


Fig. 25. One of the highest points of the upland surface of Tangnu-Ūla S from Dshagatai kul. Weathering forms in granite.
Photo. H. Hausen

BACKLUND's party followed the Khory valley upward from its mouth. At the entrance there are outcrops of greenstone, forming a narrow gorge. Here the rock contains pyrite and also small quartz veins. The vertical jointing planes produce steep walls. Greenstones still occur further SW:ward up the valley, and also above a junction of a smaller side valley from the left. The upper course of the valley is bent to the SE and thus gets the character of a longitudinal valley, while the lower part is a crossgoing gorge. Up the slopes of the valley head there are boulders of greenstones. In one locality a dike of orthoclase-porphyry was seen. After reaching the upland plain and the route of the preceding excursion the party passed further S:ward down to the flat upland valley, seen in the fig. 24. Then it ascended the opposite slope (S:ward) where great masses of granite boulders are accumulated. The rock is coarsegrained. The crest to the S of the flat bottomed valley consists of greenstone, but downward to the S there is again granite. The last mentioned rock crosses the former as dikes. The greenstone part may be a roof remnant on the batholith.

Between the Khory valley and the Turgenkhem no observations were made in the mountains. We may thus at once turn over to the last named river and follow it upward from the mouth (Sosnoffka).

The geological conditions at Sosnoffka have already been described in detail (see: The Central Uriankhai steppe area, page 88).

This valley was passed by the writer in a hurry, without any possibility for a nearer examination of the geological conditions. Some data have been collected during a short trip up the valley by SEDERHOLM. The hill-slopes rising to the E from Sosnoffka are composed of a reddish, rather strongly pressed granite. This rock is soon replaced by a quartz-amphibole-andesite (sp. 16 a, 16 b, thin sections, SEDERHOLM). The contact line was encountered ab. 1 verst E of Sosnoffka, on the right side of the river. The following hill sides up the valley consist all of the andesite, until the broad terrace plain is enterd. The river crosses it in a canyon like gorge ab. 20 m deep. In the profiles the main rock is granite, crossed by numerous dikes of andesite. These dikes stand generally vertically or steeply. Sometimes they are also branching. The thickness varies between some m and a few dm. Further upward in the right slopes there are parts of crystalline limestone (sp. 17, SEDERHOLM). Still further upward a grey gneiss (19, T. s., SEDERHOLM), crossed by dikes of andesite is met with.

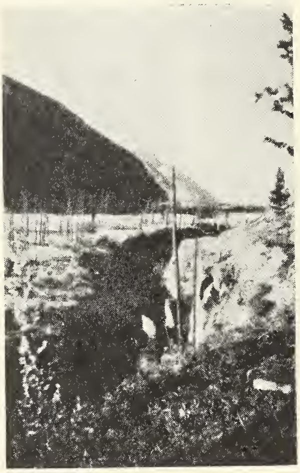


Fig. 26. Gorge in the lower part of Turgenkhem, cut in an older river plain in oedrock of granite. N side of Tangnu-Ūla, looking downstream.
Photo. E. Lindén.

There are great quartities of granitic boulders in the torrent bed of the Turgenkhem, where the path from Karakul turns into this river valley.

The canyon dominates only in the middle part of the valley, where the broad, old river plain is developed (see the fig. 26). Upwards the profile soon gets V:shaped, and the gradient rises considerably.

2) The middle subsector: Turgenkhem — W Kuk-Seylikhem. (HAUSEN).

This part of Tangnu-Ūla has been visited only by the writer, the first time starting from the farm OGNIOVA and ascending to the main crest of Tangnu-Ūla along the gorge of the W Kuk-Seylikhem. Then he passed along the main divide from W to E and arrived at the depression (intermontane valley) of

Karakul. From here he crossed the divide in the N and descended the valley of Turgenkhem to Sosnoffka. The second time the writer passed from N. Nikolsk up the Urgailik valley to the washing works of Tchernevitch. The third time he crossed the divide between Bereozoffka and Bolshoy Shangán, coming from the N. The last time he started from Shoki (middle Eleges), following the carriage road to the farm Ogniova and from there, the Ungesh valley and the Kyzyl-Erek gorge upward to the watershed reaching again the gold claims of Tchernevitch. Then he travelled from the watershed E:ward to the head of Tsingá, turned S to Karakul and arrived at last back to the farm Ogniova along the Tarbagán and Ungesh valleys.

The following descriptions will go generally from E to W, not regarding the chronology of the routes.

The riding path from the Turgenkhem valley upward to the divide and then down to Karakul leads the traveller from the Yenissei drainage over to the Mongolian drainage, because this lake has its outlet to the S. In the watershed the dominating rock is of basic habit (»greenstone») of eruptive origin. It encloses larger or smaller parts of crystalline limestone (sp. 46, Hausen). At the easternmost valley heads of the Bolshoy Shangán system there is a great body of limestone. At the head of the valley Tsingá there is also limestone showing contact phenomena on the limit to the greenstone (sp. 46a, 50, Hausen). There are also occurrences of magnetite ore in quite considerable quantities, a result no doubt of contact influence. The greenstone eruptive assumes sometimes a more coarse porphyritic habit (sp. 45, Hausen).

The greenstone-limestone complex is penetrated by granite, partly reddish and acid, (sp. 47, Hausen) partly grey and more granodioritic. The granite encloses large veins of pure quartz.

When following the flat bottomed valley from the watershed down to the Karakul lake depression, one observes, that the dominating rock here also is a greenstone of typical habit. In the torrent bed most boulders and pebbles consist also of greenstone.

The open profile of this southward leading valley and its insignificant fall gradient stand in an obvious contrast to the vigorous erosion manifestations in the N slopes of Tangnu-Ūla. This difference is due to the rel. high position of the local erosion base of the Karakul depression (cf the itinerary map n:o 1).

When following the main watershed W:ward from the E sources of Bolshoy Shangán between the latter valley and the Karakul depression the outcrops observed are chiefly of red granite, greenstone and limestone. The granite is the youngest rock.

A good geological cut through the N side of Tangnu-Ūla offers the gorge of the little torrent Urgailik (Arkholik), the right head arm of which is the above mentioned Tsingá. The gorge leads from the main watershed with a considerable fall down to the steppe, where the insignificant village Nishnyi Nikolsk (a Tatar settlement) is situated. The mouth of the gorge is forelaid by a great gravel fan, partly dissected by latter erosion. The gorge was followed by the writer from the mouth to a point, where the two head arms are joined to form the main torrent (gold washing works of Tchernevitch).

At the entrance from the steppe to the gorge there are steep walls on the right side consisting of a dark tuffite and volcanic agglomerates of a somewhat metamorphic shape. When going upward a little distance, one observes a sudden change in the rock walls the pyroclastic masses being replaced by red aplitic granite. The contact against the tuffites is of clearly intrusive character. Further up the gorge there follows a dense greenstone, which is penetrated by a grey granite forming in parts greater breccias with the basic rock. The granite is traversed by dikes of an aphanitic diabase. Still further upward a dense basic rock of tuffitic habit appears. This last mentioned is in parts schistose with an orientation N 55° W.

The boulders and pebbles in the torrent consist of granites, greenstones, tuffites and pyroclastic rocks of coarse habit, and of red Devonian sandstone in a considerable number. The last mentioned lead their origin from a down-faulted part of red strata, occurring in the upper course of the Urgailik (a tectonical prolongation of the throw of Bolshoy Shangán). The Urgailik gorge crosses this sandstone zone.

The deep valley of Bolshoy Shangán ending in the steppe somewhat W from the mouth of Urgailik, has rather the character of a longitudinal throw, running on nearly its whole length parallel with the N foot of the mountains. In reality the valley is controlled by longitudinal dislocation lines (see below).

The writer traversed the mountain ridge, which separates Bolshoy Shangán from the steppe, on a rough path from Bereozoffka S:ward. Then he crossed the torrent Bolshoy Shangán and arrived at the gold washing works of Tchernevitch in the little left tributary to the main torrent, the Mikhailovsky Kliutsh.

When ascending the slopes S from Bereozoffka, one meets first with outcrops of redbrown sandstone in vertically tilted layers. The orientation of the rock is N 60° E. This tectonical position is apparently connected with the general marginal tectonic of Tangnu-Ūla. Further upwards follows a grey, nearly quartzitic sandstone in a flat lying position. Over this rock there lies a hcocolate brown porphyrite with great lathformed phenocrysts of plagioclase.

Still further upward no bedrock could be detected, but the boulders in the slopes consist chiefly of grey quartzitic sandstone, a coarse grained porphyrite and also of aphanitic basalt. Upon this complex there lies, on still higher levels, a red psammitic sandstone, partly conglomeratic. The pebbles of the last mentioned type are badly worn (arid clima detritus). The sandstone is overlaid with a mass of aphanite, reaching nearly to the top of the ridge and forming steep walls. In the very crest the aphanite is again overlaid with a sandstone of coarse conglomeratic habit. This rock is of reddish colour and forms large banks, dipping ab. 30° S. The whole upper part of the ridge and especially the S slopes are composed of these sandstone beds.

From the crest of the ridge the writer followed a path, leading down a steep creek to the Bolshoy Shangán valley. Downward the slopes on this side are composed chiefly of thick banks of amygduloid basalt lava. The amygdulœ consist of calcite. The rocks seems to be highly iron-bearing, and the weathered surface is crusted with limonite. Further down the slopes sandstone again appears, here alternating with basalt. Just before entering the torrent of Bolshoy Shangán, one crosses a zone of grey quartzitic sandstone, showing alternation with basaltic lava beds both steeply dipping S:ward. The series runs ab. W—E. It is evident that the steep position is due to the great dislocations, controlling the present erosion valley of Bolshoy Shangán. When crossing the torrent and reaching the smooth S slopes of the valley (further away the walls are steep again), one observes that the bedrock consists of red sandstone layers, steeply dipping S:ward and running N 75° W. The edges of these strata may be crossed higher up into the gold washing creek of Michailovsky Kliutsh at a point, where the steep mountain walls rise above the gravel covered slope (see the schematic section fig. 27). Here old metamorphic rocks appear s. a. greenstone, small grained and bearing zones of skarn. The rock shows signs of pressure. Some of the boulders in the torrent bed show a breccia between

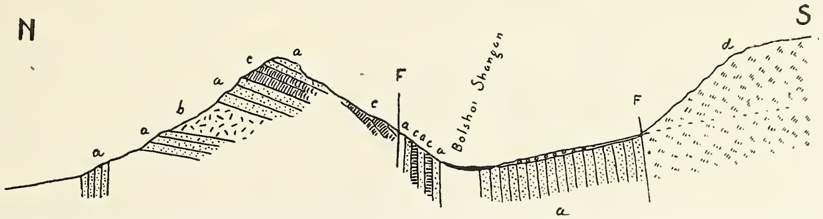


Fig. 27. A N—S schematic section through the N edge of Tangnu-Ūla and the tectonical valley of Bolshoy Shangán S from Bereozoffka. a = red or grey sandstone (Devonian) and conglomeratic layers. b = porphyrite, coarse grained. c = aphanitic or amygduloid basalt-lava. d = old crystalline rocks (greenstone, limestone, skarn, etc.). F—F fault lines. Drawn by *H. Hausen.*

greenstone and granite, the latter not encountered in the bedrock. In the skarn-like varieties of the greenstone there are more or less concentrated magnetite ores.

The boulders in the torrent bed (at the gold washing works) are greenstone, finegrained and often carrying zones of skarn, limestone or quartz. In the skarn there are grains of pyrite and chalcopyrite. Some of the boulders consist exclusively of a skarn mass. Other boulders are of a reddish granite, a coarse grained diabase, limestone and even of magnetite, which sometimes is of a remarkable purity.

Now we may turn over to the Karakul depression and then follow the valleys leading westward.

The depression in the midst of Tangnu-Ūla, where the little fresh water(?) lake Karakul occupies the deepest part, is a typical intermontane valley of tectonical origin, like the lower part of the Uss valley in the Sayan Mountains. Its bottom lies considerably higher than the foot of the mountains in the N and S (the Bielotzarsk and the Ubsa-nūr steppes). There is an outlet to the S through a narrow gorge in a mountain wall on that side. The continental divide follows thus the N walls of the Karakul depression, as already mentioned. To the E the depression seems to have a long extension (no survey has been made in this part), and to the W it is immediately connected with the long and narrow mountain valley Kyzyl-Erek, leading down to Eleges. Only a low saddle formed pass divides the Karakul depression from the latter. But in reality this divide is the continental one, because Kyzyl-Erek drains to Yenissei. Here also a remarkably low pass has been formed, not encountered, as far as the writer knows, from any other part of the Tangnu-Ūla chain. The W:ward prolongation of the Karakul depression, the valley of Kyzyl-Erek, stands apparently in the nearest tectonical connection with the former, as will be discussed closer in an other part.

Like the analogous intermontane throw-valleys the bottom of the Karakul depression may consist of a sunk remnant of Devonian sandstones, once covering the whole area, but removed by the erosion from the uplifted parts (the upland plains). Any outcrops of this formation were, however, not detected by the writer in the vicinity of the Karakul lake. The ground is up to the edges of the bordering mountain sides covered with a grass grown stony soil or marshes. But in the prolongation to the W, the Kyzyl-Erek valley, there are smaller parts of the sandstone formation. In the midst of the lake depression a great hill of the ground rocks rises over the alluvium and the lake surface, but also this is hidden beneath the soil cover.

The Karakul lake is fed chiefly by underground waters descending from the surrounding mountain slopes. It has, as mentioned, an outflow to the S, into Mongolia. The little river meanders first over a plain grass ground until it reaches a mountain gorge, through which it rapidly descends to the plain of Ubsa-nūr.

The writer made some observations in the mountain slopes to the NW and SW from Karakul. In the former direction the slopes consist chiefly of greenstones and limestone, both often in alternating bands with a general strike N 35°—37° E. On the limits between the two components there are often zones of skarn. The dominating member is the greenstone, evengrained, but at the contact with the limestone hornstone-like. The two mentioned rock types are cut across by a granite, acid, grey and evengrained, appearing partly as more well limited masses, partly as dikes. At the contacts the usual greenstone changes into a more coarse grained amphibolite (sp. 52, HAUSEN), or even, in case of pnematolytic action (?) into a still coarser amphibole fels (sp 51, HAUSEN).

The granite here is the same type occurring in the higher parts of the mountains to the NW, at the sources of Bolshoy Shangán, were it penetrates the limestone complexes.

The mountain ridge to the SW from the lake of Karakul (the watershed between the Karakul depression and the Tarbagán river) is chiefly composed of diorite (amphibole diorite) of a somewhat changing aspect (varying acidity).

When following the mountain slope westward one arrives at the above mentioned low pass in the continental divide, from whence Kyzyl-Erek originates. Somewhat to the W from the pass the slope (of the same chain as above) on the left side of the valley consists of a grey granodiorite of quite even grain. There are all stages of assimilation of amphibolite into the surrounding rock. A such syntectic product is a gabbroidal rock (sp. 28, HAUSEN) with well individualized feldspars and a groundmass of amphibole.

Opposite the slope lies the mouth of a mountain gorge, descending from the N and being a right head arm of Kyzyl-Erek. The writer passed up this gorge to the watershed studying the rock sides all the way to the head of a right arm and finally reached the head of Mikhailovsky Kliutsh, lying on the opposite (N) side of the divide. By the natives the gorge is called Kuk-Seylikhem.

At the entrance to the gorge, on the right hand, there are steep cliffs of a pressed quartzite (sp. 29, HAUSEN) containing epidote-crusten gliding surfaces. This rock seems to have a quite considerable extension, judging also from the numerous boulders of this specimen in the valley bed of Kyzyl-Erek surther downward. When going up Kuk-Seylikhem from the mouth one arrives roon at a point, where two head valleys are joined. The writer followed the fight arm. Somewhat upward there are steep cliffs of a redbrown, slaty limestone (sp. 36, Hausen), alternating with layers of white limestone. Further upward there are masses of peridotite (sp. 35, Hausen) and a greenish, even grained rock, containing small grains of a white, metallic mineral, an altered olivine gabbro (sp. 33, 34, T. s., Hausen). The contact between the limestones and the intrusives is not visible here. Among the boulders in the torrent there are, except the basic eruptives, breccias of a fine grained basic rock with epidote as cementing mass (sp. 32, Hausen).

The mountain crest above the head of the creek just described consists of a strongly pressed calciferous greenstone (sp. 31, T. s., Hausen). The general strike of the rock is W—E. When going N:ward in the direction of the head of Mikhailovsky Kliutsh one observes that the greenstone gets more massive without signs of pressure.

The higher mountain slopes around the head of Mikhailovsky Kliutsh consist chiefly of a black-greenish dense, or grained rock of somewhat changing aspect, being partly pressed and weathered. They seem to be closely associated with the greenstones, although an amygduloid aspect often is found (sp. 37, 38 T. s., 39, 40, 43, Hausen). They carry sometimes a greater or smaller amount of magnetic iron ore (sp. 41, 42, Hausen), the latter occurring in parts as real ore bodies, judging from loose boulders in the torrent bed below. Boulders of a high degree of purity have often been found in the washing-placers in the lower part of the same valley.

These basic rocks are penetrated with a small grained, syenitic aplite (sp. 44, Hausen), in parts forming breccias with the main rocks.

The writer followed the Kyzyl-Erek valley up to its head. It is a typical fissure- or tectonical valley of longitudinal character. In the upper part of the course the dominant rocks seem to be amphibolite, diorite and a hornfels-like type carrying zones of skarn (garnet and epidote). All these specimens can be studied in the boulders in the torrent bed. Downwards the valley widens and is occupied by dislocated Devonian strata. These are of different colours and dip 55°—70° NE, or even vertically (in the upper part of the area in question) with a strike N—S. There is no doubt, that this »Devonian» area, on all sides surrounded by high mountains of old crystalline rocks represents a sunken part of the once widespread Devonian formation.

Further down the valley the main rocks are granites and granodiorites of the grey Tangnu-Ūla types. Also the boulders in the torrent bed consist chiefly of these types. The valley ends in the broad longitudinal throw, used by Ungesh and Eleges in their courses down to the steppe. The torrent Kyzyl-Erek joins Ungesh somewhat below the entrance of the latter into the broad valley.

Tarbagán is another mountain torrent joining Ungesh also from the right side. It heads in the mountain ridge limiting the Karakul depression from the SW and flows in a southward directed bow through a similar mountain gorge as Kyzyl-Erek. In the upper part of the valley (which is of a broader profile) the dominant rock is a granodiorite of a somewhat changing degree of acidity. Further downward the left slopes of the valley are composed of a greyish black lava rock with a pale weathering crust. The rock contains numerous cavities filled with calcite and also cracks, filled with the same mineral (sp. 55, HAUSEN). It is cut across by dikes of a distinct plagioclase porphyrite (sp. 54, T. s., HAUSEN), consisting of a dark, dense, groundmass and white plagioclase phenocrysts. The rock may be interpreted as a very altered hyperstene-porphyrite. Older than the amygduloid rock is a quartz bearing porphyrite (sp. 53, T. s., HAUSEN). The N side of the Tarbagán valley seems to consist partly of a fine grained effusive (?), partly (somewhat lower) of a dark gneissic rock (sp. 56, T. s., HAUSEN), amphibole bearing. It contains zones of limestone. The general strike is ab. NE at the middle part of the valley. Somewhat lower the strike is N 10° E and the dip is steeply E. Here the gneissic rock is intruded with granite. When climbing the S side of the upper course of the Tarbagán valley one reaches the continental divide or the main crest of Tangnu-Ūla with an outlook over the S slopes and valleys down to the plain of Ubsa-nūr.

The writer followed also the upper Ungesh valley from its head in the main crest of Tangnu-Ūla. It is a straight running gorge with a sudden bend, from N to NW, apparently controlled by two divergently running fault lines. In the upper part of the valley the geological composition seems to be very varying with many kinds of greenstones etc. (sp. n. c.) but further below greyish granites and granodiorites dominate. In the torrent bed there are huge masses of boulders of the same rocks. The fall of the upper Ungesh valley is always considerable.

The lower course of the Ungesh river runs, as said, through the open valley followed also by the Eleges river. The two streams are joined at a point, where the N wall is lowest. Ungesh has transported an enormous mass of boulders, nearly all consisting of grey granodiorites, outcropping also in the low mountain sides along the lower course of Ungesh (the right side). From the left hand the river receives the E Kuk-Seylikhem, a wild mountain torrent, coming from a gorge in the mountain block, bordering the Eleges valley in the S. The torrent of the latter is also filled with boulders of the grey granodiorites, indicating that these rocks also occur in the mountain sides to the S.

The section of Tangnu-Ūla bordering the Ungesh-Eleges valley in the S is of greater heights than the crests farther E. It has also a more marked plateau-like shape with an abrupt N slope towards the valley. The writer followed the watershed of this mountain sector from the lower course of W Kuk-Seylikhem to the head of Ungesh. Along this route one gets a good look at the morphological features of the mountains. An upland plain of gentle undulating aspect is still preserved to a great extent in spite of the vigorous erosion in the gorges, descending on both sides of the main divide. The head water work has not yet resulted in any crest, but a part of the upland surface is left back. The erosion may thus be in a still youthful stage. The smoothness of the upland surface is, however, not an original one, but the result of an intense weathering of the bedrock, which is visible only in the form of monument like rocks standing generally on a culminating point of a flat dome (see the fig. 25). All the other ground is hidden beneath a moist soil of chiefly rock débris, showing characteristic solifluction phenomena.

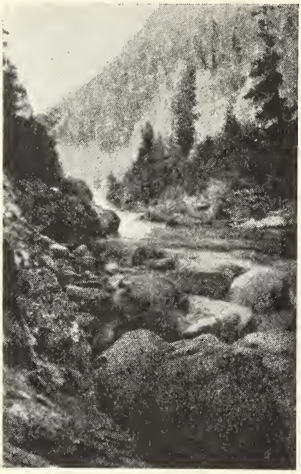


Fig. 28. The torrent Kuk-Seylikhem in the N side of Tangnu-Ūla, Eleges drainage. The gorge is eroded in granite. Looking S. *Photo. E. Lindén.*

The timber line occurs at this smooth upland surface on altures of ab. 2,000 m.

Only few and sporadical observations were made of the composition of the rocks in the higher parts of Tangnu-Ūla. The common specimens seem to be grey granite and granodiorite, the latter leading over to diorite and even amphibolite (assimilation of amphibolite into granite?). The amphibolites are often slaty, due to pressure, and have been altered to chloritic schists. These pressed varieties contain often veins of quartz.

From the main divide the writer observed that in southerly direction, at the S foot of Tangnu-Ūla, red coloured hills appear. These consist no doubt of Devonian layers, fringing the mountain horst-wall in the S. Also the detailed sculpture of there hills speak of the mentioned composition.

The writer followed the deep and narrow gorge of W Kuk-Seylikhem upward from its mouth in the broad intermontane valley Ungesh-Eleges. The gorge cuts straight through the mountain block and offers a good view into the geological composition of the latter (fig. 28).

After reaching the apex of the enormous gravel fan forelying the mouth of the gorge, one enters a boulder loaded torrent bed. The wall of this bed consists of a greenstone, partly finegrained, partly evengrained, and being rather a diorite than an amphibolite. Further inward (upward) there follows a grey, middle grained amphibole granite, injected into the former rock. In many parts there are fragments and even great parts of the greenstone, lying in the granite. Often the fragments are partly or nearly completely resorbed into the granite, a phenomenon causing all stages of basicity of the enclosing rock.

The basic rock can locally show a marked schistosity and in this case the amphibole has been transformed to chlorite. The rock contains numerous veins of milkwhite quartz, carrying pyrite.

The greater part of the boulders in the torrent bed consists of a massive amphibole granite and granodiorite.

The valley profile is not simply V:shaped, but has a marked canyon in the bottom, due to a more recent rejuvenation of the erosion as the result of a contemporaneous elevation of the mountain block.

3) The W subsector: between the W Kuk-Seylikhem and the Tarkholik Pass (HAUSEN).

This sector of the mountains may comprise also the N wall of the Eleges intermontane valley, although this ridge really is only a forerunner to the main chain of Tangnu-Ūla.

An interesting profile through the mentioned lower chain can be studied in the water gap, formed by the crossgoing Eleges below the junction with Ungesh and above the settlement Shoki. The succession of rocks upstream on the left side is as follows: first basic lava beds, then strata of an arcose-sandstone of brownish colour dipping steeply N:ward. According to RATCHKOFFSKYS verbal communication there are no fossils whatever in this rock, but he considers the age as lower carboniferous. The strata lie on a thick series of dark andesitic lava banks showing partly a conformity, partly an unconformity to the overlying sandstone. The lava series rests on an anticline of red sandstone layers (see the profile, fig. 29). To the S these are cut off by a fault (F), thereafter follows for a great distance well bedded Devonian limestone and marl with a steep profile against the river. The limestone is grey, dense and wholly unmetamorphosed[1]. When going further up the river, one observes, that the limestone is upbent by a fault (F) against a wall of greenstones occupying the whole wall of the gorge up to the junction of Ungesh, on both sides of the river. The main types here are porphyrite (sp. 25, HAUSEN) and aphanite, intercalated with tuff sheets (sp. 59, T. s., HAUSEN). The whole series is nearly vertically tilted. It has a great similarity to the effusive rocks (lavas and tuffs) occurring in the N sides of Tangnu-Ūla farther E:ward, and are thus probably older than the granite instrusions. The general orientation is ab. E—W. Just below the junction of Ungesh with the main stream, in the greenstone series occur some dikes of a reddish quartz-porphyry (sp. 57, Hausen) with quite large phenocrysts of red feldspar and grey quartz. The rock shows no signs of pressure.

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[1] The fossils found in it have been determined by METZGER as middle Devonian.

Following Eleges still further upstream to the vicinity of the farm Ogniova (situated on a broad river terrace at the N wall of the upper Eleges-Ungesh valley) one finds a greater mass of red granite, partly finegrained, partly also mediumgrained and generally of a syenitic character (sp. 26, Hausen). This rock is apparently closer connected with the above named quartz-porphyry dikes, cutting through the greenstone series. The granite encloses greater and smaller parts of an aphanitic, nearly black diabase (sp. 58, T. s., Hausen), which composes chiefly the higher parts of the mountain ridges N of the mentioned farm.

NW of the farm there is a cone shaped mountain peak consisting of pale coloured and well stratified layers of fine grained tuffite. They dip SW.

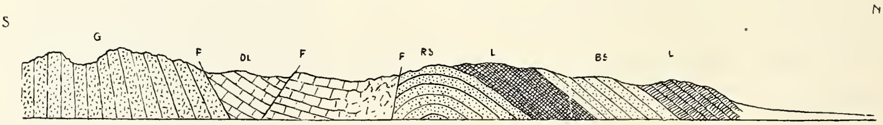

Fig. 29. Schematized section along the left side of the Eleges river between the junction of the Ungesh and the village Shoki. River course from left to right. G- greenstones, tuffs. DL- middle Devonian limestone and marl. RS- red sandstone, prob. Devonian. L- lava. BS- brown sandstone. F, F, F- faults.

Sketched by *H. Hausen*.

The relation of this rock to the other of the same mountains is not clear (sp. 27, T. s., Hausen).

The rugged ridges SW from the farm consist mainly of limestone. This rock is well banked and but slightly metamorphosed. The dip is nearly vertical or steeply S. The strike is N 80° W. This strong dislocation may perhaps be due to the formation of the Ungesh-Eleges tectonical valley, where the N wall is also composed of strongly dislocated strata of chiefly Devonian and pregranitic greenstone series. To these strata the limestone ridge shows no immediate relation. A resemblance with the limestones of the »Ulukhem series», described in an earlier chapter, is, however, very striking. On its N side the limestone ridge is accompanied by an also vertically tilted sheet of aphanitic lava. Further N:ward another ridge is composed of limestone. There are no dikes of granite or quartzporphyry in these rocks.

Another time the author followed the carriage road from Shoki to the farm Ogniova. The first slopes passed, facing N, westward from Shoki consist of basic lava, extending some versts W:ward. This formation lies apparently on the arcose-sandstone beds, described in the profile, fig. 29, and are probably of lower carboniferous age. The lava beds dip N. After following the foot of the lava slopes W:ward the road turns suddenly S:ward, traversing in a dry crossgoing gorge a series of slaty sandstones steeply dipping S:ward. The strata run N 60° W. Further to the S the gorge gets more open, and layers of red sandstone appear, intercalated with sheets of dark lava. The dip is now less steep to the S. Further in the same direction there is an open rolling steppe ground. To the right (W) there is a somewhat higher, smooth crested ridge consisting of sandstones of reddish colours.

On the just described route there are thus, as far as seen, only the clastic strata and no outcrops of the old crystalline rocks, contrary to the Eleges profile below the confluence of the Ungesh.

On the way to the farm Ogniova the writer followed a flat bottomed valley downward in the direction S 30° E. To the left the slopes consist of granite and greenstone with tuff-banks in the cone shaped top in the foreground (see above). To the right there are rugged hills and ridges consisting of the upturned limestone and the lava formation.

When following Eleges upstream from the farm, and after passing the limestone ridge one observes on the right hand in a farther distance more smoothly formed ridges. These are composed of a lava formation of reddish colours in mighty N dipping banks, showing a columnar jointing vertically to the beddingplanes. The cuesta formed to the S has subsequently been dissected by the erosion into a number of cone shaped knobs offerring a peculiar aspect.

This lava formation seems to rest on a pale brownish sandstone outcropping in the lower part of the slopes down to the river and showing a N dip.

Going further up Eleges one arrives at a point, where the river makes a sudden bend around a cape consisting of the NW end of a lower sandstone ridge. The sandstone is of brownish colour. In the vicinity there are also other hills and ridges consisting of sandstones and showing various dips. Also flexures are to be seen.

The boulders in the stream bed of Eleges show a great variety of sandstones and lava rocks. Some boulders consist of greenstones and granites of the usual Tangnu-Ūla types. The scarce occurrence of old crystalline rocks stands here in a striking contrast to the abundance of such rocks in the boulders of the torrents, descending from Tangnu-Ūla farther E:ward.

From the above mentioned bend the writer followed the river upstream to its head waters in Tangnu-Ūla.

On this way there are to the right (on the left side of the river course) lower slopes all consisting of sandstone strata showing various dips. The slopes rise to an even sky-line, a now dissected peneplain surface.

It is beyond doubt, that the flat bottom of the intermontane valley, followed by Eleges, is also composed of the same sandstone formation, now covered with a mighty sheet of mountain gravels and sand. Only the long ridge rounded in the NW by Eleges is a remnant, rising over the gravel sheet surface.

When going up the Eleges a great panorama is obtained to the S over Tangnu-Ūla and its abrupt N slopes. On this sector the fall is very little dissected by erosion. No cross going valleys like the W Kuk-Seylikhem are to be seen. The upland surface shows a very distinct peneplain character. The slopes are composed of some darker rocks enclosing parts of bright colour, probably granite injections.

Further up the same river the sandstone terrane on the left side grows higher and the intermontane valley gets narrower to the W. The western end is, however, widened into a kettle shaped depression with a plain bottom. This plain is crossed by Eleges descending from the crest of Tangnu-Ūla in the S.

The uppermost course of the Eleges river, upward from the plain is mostly a typical mountain valley. The writer followed it up to the divide (the Eleges Pass, 2,000 m ab. the sea).

When entering the erosion valley and leaving the flat bottomed depression a pale brownish sandstone formation in flat lying positions is observed to the right (left side of the river). It forms a cuesta to the S, running along the high slope of Tangnu-Ūla. The valley between these is used by the upper Eleges.

Somewhat above the crossing of the mentioned sandstone ridge the Eleges river receives a right tributary, the mountain torrent Rögetchi. It was followed by the writer nearly up to the sources. The lower part of the valley is open and formed into some broad terrace plains. Upward the profile soon gets narrower, and the torrent flows between steep walls of the bed rock. First layers of a chocolate brown sandstone steeply dipping and dikes of diabase are noticed. Further up the gorge follows a series of greybrown sandstone alternating with conglomerate. The dip is steeply N:ward. Upward from the mouth of the little left tributary Ak-khem the profiles show pressed diabase and redbrown tuffite (sp. 60, HAUSEN).

The boulders in the torrent bed consist chiefly of the above enumerated rocks, but there are also boulders of the Tangnu-Ūla greenstones, indicating that rocks of the last mentioned kind occur in the upper part of the course of the gorge.

The strongly dislocated sandstones, lava rocks and tuffites appearing in the deep profiles of Rögetchi belong without doubt to the Devonian basal series and have been tilted against the block of old crystalline rocks, outcropping in the described Tangnu-Ūla mountain plateau further E. Westward from this gorge the whole chain of Tangnu-Ūla is, as will be seen, composed exclusively of the Devonian formation.

The gorge of Rögetchi follows thus nearto an important geological limit in Tangnu-Ūla. It is moreover a typical example of rejuvenated erosion occurring quite frequently in Tangnu-Ūla.

The uppermost course of Eleges lies in a still deeper gorge than Rögetchi. The former follows the E slope of a steeply dome shaped mountain, where a long series of Devonian strata is exposed. These consist of a variegated series of red, brown and grey sandstones, interstratified with slates and conglomerate beds. The strata are in the lower part of the gorge nearly vertically tilted, upward they show a dip of 45° S. At the head of the gorge (the Eleges Pass) the strike of the strata is N 75° E with a NNW dip of 45 (?). Further E:ward it seems as if the strata are oriented more to the N and fall gently W:ward.

The outlines of the mountain forms are more smooth here excepting a ridge to the E (between the Eleges Pass and the sources of Rögetchi), where the strata are steeply tilted and have caused corresponding erosion forms. To the SW of the Eleges Pass there is a smaller frontal moraine lying in a little valley leading down to the Mongolian side.

Where the upper gorge ends, the torrent makes a sudden bend to the E thrown aside by a cuesta of sandstone layers (see above). Here the strata show a gentle dip to the N, but in the cuesta-profile they appear nearly horizontal.

From the lower end of the gorge the writer followed a trail leading W:ward along a narrow water gap of a small left tributary to Eleges. The profiles here show sandstones running ab. N 70° E and dipping N:ward. After passing this water gap one enters a flat bottomed valley on all sides surrounded by mountains and hills. The writer followed the N side of the bottom going west. The S side is bordered by the high slopes of Tangnu-Ūla, which have very uniform and smooth outlines, as is characteristic for the sandstone terranes. Along the N wall of the valley bottom the rocks consist also of sandstones dipping in different directions.

After passing a couple of versts to the west the writer turned N:ward into a narrower valley, leading up to a mountain crest, a N branch of Tangnu-Ūla in the N. This valley has an open profile and a mighty gravel train. The slopes are covered with soil.

At the mentioned mountain crest the author reached the sources of the river Karadr, leading down to the Tarkholik river, a left tributary to Ulukhem. The valley of Karadr is bordered by high mountains and shows everywhere sandstones, dipping ab. 45° SE. The sandstones are quite uniform in shape and brownish-grey in colour.

Below the confluence of the Karadr and Tarkholik valleys the latter gets broader and flat bottomed. These mountain sides are still composed of sandstone strata dipping ab. SE. On the sides of the stream there are broad terrace plains. (Continuation to the N, see page 86).

4) Supplementary notes.

Observations made by POTANIN (1883) during a Crossing of Tangnu-Ūla in the year 1879.

Potanin left the shore of Ubsa-nūr at the mouth of Ubùr Tarkholik (Mongolian) and marched N:ward up to the Mongolian frontier guard Zyzyrgán, situated at the foot of Tangnu-Ūla. At the E side of Tarkholik there is a group of hills, known as salt bearing. These hills consist of red sandstone, interstratified with layers of grey sandstone. This formation encloses seams of salt. To the N from the E head arm of Tarkholik, Khurgón Shibir, the real slope of Tangnu-Ūla begins. Potanin continued up the uppermost gorge of Tarkholik, Amryk. These mountain sides are composed of sandstones. In the torrent bed a boulder of a conglomerate with small pebbles was found. — After passing the divide of Tangnu-Ūla Potanin descended a narrow gorge (Arr Amryk) leading down to the Arr-Tarkholik (trib. to the Ulukhem). The bedrock here is likewise of the sandstone formation (finegrained, dark or pale greyish). Further down the valley a sandy clayish slate, a dark red clayish marl and a grey limestone were met with. Nearer to Ulukhem old crystalline rocks outcrop (cfr. page 86), s. a. granite and »gneiss».

Observations made by KRYLOFF (1903) when crossing Tangnu-Ūla in the year 1892.

The first time Kryloff reached Tangnu-Ūla he came from the N following the valley of Kuile upward (head arm from the left to the Arr-Tarkholik). At the sources of the named torrent he ascended a top. Here the mountains consist of a thick-bedded, dark grey, calciferous sandstone, nearly flat lying. Also layers of brown sandstone occur in the upper levels.

On the S side of Tangnu-Ūla Kryloff descended through the narrow gorge of the Peste Karasuk and then he followed the Ak-khem leading down to the Ubúr-Tarkholik. This valley was then followed down to Ubsa-nūr. The Tuss

Tagh mountain, rising on the E side of the lower Ubúr Tarkholik, is composed of nearly horizontally lying strata of a reddish grey sandstone, partly showing transition to a finer conglomerate. The salt occurrence visited by POTANIN lies in this mountain. (POTANIN calls the locality Dshirgilingty).

After reaching the shore of Ubsa-nūr KRYLOFF turned back to the N, this time following the little stream Kady, draining to the northernmost bay of Ubsa-nūr. The mountain sides on both sides of this valley are composed of a greenish grey porphyry without quartz. Still further up he reached the little torrent Ak-Karasuk, a right tributary to the Irbittey. Also here porphyry was found. The divide of Tangnu-Ūla was crossed in the Eleges Pass. Further geological observations are lacking.

D. The Beikhem Drainage Area.

1) Observations made by the NORWEGIAN SCIENTIFIC EXPEDITION (OLSEN), 1914. Route: (Minussinsk — Kushebár — Kálna —) Algiak Pass — Ust Algiak (side exursions to »Altaian» and Tshernoretshka) — Sistikhem — Ust Sistikhem — Zaimka LOBANOVA (Khamsará) — Zaimka SAFIANOVA — Zaimka PETROVA, MOSGAIEFFSKAVO — Kuria — Zaimka SAFIANOVA — Beikhem (and Ulukhem) downstream by timber float.

On the way from Karatús to Kushebár the steppe formation ends and the first hills of eruptive rocks appear. They are often bordered by small up-broken parts of the table-land formation (»Devonian»). In the vicinity of Kushebár the last remnants of the sandstone formation have wholly disappeared and the great eruptive area of the Sayan Mountains is met with. A backstone red granophyre was taken from the last mentioned locality (sp. 1, T. s., OLSEN). 7 (Norwegian?) miles up the Amyl river there are outcrops of a porphyrite (sp. 2, 3, T. s., OLSEN) of a dark brownish colour and weathered (sericite, chlorite, etc.). In the same locality a slaty greywacke with large grains of quartz was found (sp. 4, OLSEN) probably belonging to the basal layers of the Devonian formation. The porphyrite has a great resemblance to the sub-Devonian effusives in other localities. It belongs to a formation of a wide extension in this part of the Minussinsk district.

Further upward along the Amyl river an area of deepseated igneous rocks is met with. The dominant types at the locality Semiretshka are quartzmonzonitic varieties (sp. 5, 6, 7, 8, T. s., 4, 5, 6, 7, OLSEN) middle- or small grained and greyish in colour. There are monzonite porphyrites as well (sp. 9, 10, T. s., 8, 9, OLSEN) belonging probably to some dikes, connected with the main eruptives. At Semiretshka (400 m ab. the sea) the Amyl valley is already mountainous. This character is still more accentuated at Kálna (500 m ab. the sea) a Russian settlement. The Algiak Pass in the main divide of Ergik-Targák-Taigá, lies 1413 m ab. the sea. It is a broad saddle formed depression in the mountain range, lying far below the timber line. From this Pass the little river Algiak was followed downward to Ust Algiak, the confluence with the Sistikhem river originating in Ergik-Targák-Taigá more N:ward (in the »Altaian» Mountain).

At Ust Algiak a greenish, finegrained dioriteporphyrite occurs (sp. 16, 17, T. s., 10, 11, Olsen). The relations to the surrounding rocks are not known. It is perhaps some dike rock. About 5 versts NW from the mentioned locality a boulder of hornblendite (sp. 19 T. s., 12, Olsen) was found.

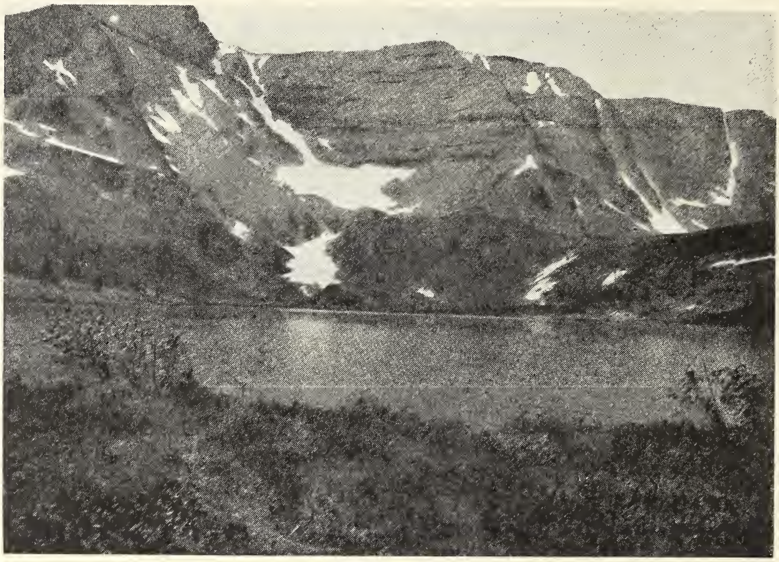

Fig. 30. Abrupt slope of the »Altaian» Mountain (Ergik-Targák-Taigá) at a head lake of Sistikhem.

Pict. communicated by *H. Printz.*

The »Altaian» Mountain, a part of Ergik-Targák-Taigá, rises to the NW from Ust Algiak and seems to be chiefly composed of abyssal igneous rocks of the norite series (sp. 21, 22, T. s., 14, 15, Olsen). The pictures communicated by Printz (figg. 1 and 2) show also no doubt an eruptive terrane, excepting fig. 30, a mountain crest at a head lake of Sistikhem, where a kind of bedding in flat lying position can be discerned. It is, however, doubtful, if the banks really represent any stratified rock. 5 versts SE from the named mountain a grey biotite granite appears (sp. 20, T. s. 13, Olsen). The relations to the gabbro massive of the »Altaian» are not known.

In a locality called Tshernoretshka, situated 2,5 miles WSW from Ust Algiak a grey, finegrained, but somewhat inhomogeneous weathered porphyrite occurs (sp. 26, T. s., 16, Olsen), probably a dike rock. In the vicinity are outcrops of a greywacke (sp. 27, 29, no T. s., Olsen) finegrained. Down the Sistikhem, 3 miles from Ust Algiak a greyish black porphyrite appears (sp. 31, T. s., 17, Olsen), weathered. In the vicinity a silicified conglomerate occurs (sp. 32, Olsen), somewhat downward followed by an arcose (Devonian?) (sp. 33, T. s., 18, Olsen) and a dark greyish quartzite (sp. 34, Olsen) very hard (contactmetamorphosed?).

Half way between Ust Algiak and Ust Sistikhem, in the vicinity of Tshebertash (see above) the first outcrops of Devonian slates are met with (Printz, 1916, page XIV), extending further downward along the Sistikhem (and further up the Beikhem river, see below). To the W the Devonian formation reaches the Seibi river (l. c. page XV). At the Ust Sistikhem W from the river are rocks of a weathered porphyrite (sp. 46, T. s., 28, sp. 47, T. s., 29, Olsen) of pale brownish colour. These rocks may perhaps be of the sub-Devonian effusive series.

From Ust Sistikhem the Expedition followed the Beikhem valley upward on the right, and crossed the lower Khamsará at the zaimka Lobanova. 2 versts from Ust Sistikhem a granodiorite area occurs (sp. 35, T. s., 19, sp. 36, T. s., 20, Olsen). Along Beikhem the Devonian formation, however, is quite unbroken (?) to the mouth of Dorakhem and also still further upstream.

The easternmost part of the Dora steppe is, according to Printz (1916, page XV) a hilly landscape with great terminal moraines. There are also several lakes of glacial origin.

From the Dora steppe down to the mouth of the Seibi river the Beikhem flows in a Devonian (?) terrane, partly between steep cliffs of flat lying strata, partly bordered by broad flood plains probably produced by a wide reaching lateral erosion of the Beikhem. The strata are generally red brown and similar to these in the Minussinsk district (sandstones, clayish slates and conglomerates).

In the vicinity of the farm Safianova at Beikhem there are outcrops of a blistery, dark greyish olivine basalt (sp. 41, T. s., 23, sp. 42, T. s., 24, Olsen), apparently of a very late age (Quaternary?). On the left side of the river, ab. 3 versts below the farm Safianova there is a chocolate brown porphyrite with small reddish feldspar phenocrysts (sp. 45, T. s., 27, Olsen). It belongs no doubt to the sub-Devonian effusives.

At Kuria, situated in the steppe NW from the big bend of Beikhem are outcrops of a darkgrey, smallgrained olivine basalt (sp. 39, 40, T. s., 21, 22, Olsen), without doubt of a late age (contemporaneous with the blistery lava at the farm Safianova?).

At the mentioned big bend of the Beikhem river, where the farms of Mosgaieffsky and Petroff are situated, rises S from the former a mountain, composed of a brownish quartzporphyry, very loaded with feldspar and quartz phenocrysts (sp. 43, T. s. 25, Olsen) and of an inhomogeneous aspect. A tuffite of a similar colour occurs somewhat below, on the left of the river (sp. 44, T. s., 26, Olsen) nearer to the farm Safianova. Both types are probably connected.

The area occupied by the Devonian formation is a basin of steppe character similar to the Central Uriankhai steppe.

»When following Beikhem downward and approaching the mouth of the river Seibi and the upper entrance of the Beikhem gorge, crossing the mountain barrier Tasküll or Artool Hrebet, one can observe, that the strata of the Devonian formation become more and more displaced, with fine folds in the profile along the river. In several places they are seen to have been broken up entirely or raised on edge. Below Seibi, the eruptive zone itself begins, continuing roughly as far as Uyuk. The average breadth of the mountain range here is 60 versts, Beikhem running all this way in foaming white rapids in deep, narrow clefts, with steep rocky walls on both sides, reaching right up to the regions of the perennial snow — — — At the mouth of the Utt, mighty green porphyrites are seen[1] extending down towards Utinsky Porog, followed downwards successively by gneisses, granites, diabases and melaphyres, whereupon porphyrites again appear. — — — About Uyuk small quantities of Devonian sandstone occur, forced into the eruptives, and farther down the Soyot steppe (the Central Uriankhai steppe) the Devonian sandstone is nearly prevailing again.»[2]

2) Specimens collected by the Russian Naturalist A. YERMOLAIEFF (1915) on a Route from the Tapsá River over the Mountains to the upper Beikhem and Khamsará.

17. Granite, right head arm to Pitchi-O.
T. s. 18. Sandstone, right head arm to Pitchi-O.
T. s. 19. Syenite, Argol-khem, source to Pitchi-O.

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[1] Perphaps identical with the greenish porphyrites in the Karakhem valley (Tapsá-drainage).

[2] H. Printz; 1921, page 90.

3. Basic schist, watershed between Ulu-O and Uruk-tuk-khem (flowing to Tarakhem).

T. s. 14. Quartzporphyry, right side of Beikhem, just below the farm MOSGAIEFFSKAVO.

6. Syenite, Khamsará.

3) Observations by KRYLOFF (1903). Route: Tapsá — Karakhem — Tomat Taigá Pereval (A-Tshalyg-Art-Tyi) — Pitchi-O — Ulu-O — Pereval Dshelam Art-Tyi — Dorakul lake — the big bend of Beikhem — the farm SAFIANOVA — Todshi-kul lake — Azass — Oiva Taigá — Noion-kul lake — Ysuk — Beikhem (downstream) — Sistikhem (upstream) — Algiak Pass — Minussinsk.

KRYLOFF arrived at the mouth of the Tapsá river from the confluence of the Huakhem and Beikhem. He followed then the Tapsá valley upward. The bedrock in the mountain slopes more to the E seemed to consist of strongly metamorphosed finegrained, partly schistose crystalline rocks of greyish-green or yellowish-brown colours.

From the Tapsá valley the right tributary Karakhem was followed upward and the Hrebet Tomat Taigá was crossed, whereafter KRYLOFF reached the upper part of Pitchi-O. In the Pass the rockfloor consists of a flesh coloured quartz-porphyry showing phenocrysts of a paler reddish feldspar and also spots of epidote.

The valley of Pitchi-O is in its upper course of quite open profile, the N wall being very abrupt. To the N from this valley a high mountain range was seen running roughly parallel with Tomat Taigá and carrying a series of jagged peaks. The summits of Tomat Taigá are, however, more smoothly formed.

Down in the valley of Pitchi-O there is an isolated hill called Meshelik. It consists of a calciferous quartzitic sandstone of a dark violet-grey colour. KRYLOFF followed this valley upward, crossed the watershed toward Ulu-O, finally reaching the last named. This valley has steep erosion walls consisting of a kind of a bright red coloured specimen, a stratified rock, where layers of clay are intercalated.

Continuing up Ulu-O KRYLOFF encountered in the rocky right side a tuffite (?) of a pale flesh colour, containing smaller spots of epidote. The rock is megascopically dense.

The E prolongation of Tomat Taigá is called Ottyg Taigá. The Hrebet was visited by KRYLOFF during an excursion to the S from the sources of Ulu-O. Also a ridge to the N from the last named locality was visited. KRYLOFF calls it »Northern Ottyg-Tash». It consists of a syenite and of a »syenite gneiss» dark greenish grey, probably a pressed quartz-diorite, judging by the description given by SAYTZEFF (1903). The rock is strongly slaty in some places, in others there is a quite normal diorite. Also a grey quartz-porphyry occurs containing spots of chlorite.

From the sources of Ulu-O KRYLOFF descended an abrupt slope to the lake Dora-kul and reached Beikhem at the farm SAFIANOVA. Here a quartz-porphyry occurs.

From a point on Beikhem somewhat above the big bend KRYLOFF went N:ward to Todshi-kul, the sacred lake of the Soyots. On the way he encountered hornblende granite and diorite (syenite?).

From this lake the traveller followed the Azass river upward. On the way he observed (nearest to Todshi-kul) a gneiss and a hornblende granite, coarse grained. Above the lake Tshevar-kul there is a mountain consisting of pale flesh coloured quartz-porphyry. At the sources of Azass the mountain summit is composed of gneissic rocks, containing amphibole and biotite. 30 versts NE from these sources an amphibole granite occurs. In the same locality there is also a dark, ash-grey melaphyre, olivine bearing. The mountain Oiva-Taigá, on the way between the upper course of the Khamsará and the lake Tavarktyg-kul is covered with débris of granite. The rocky shores of the lake Noyon-kul (somewhat down Khamsará) consist of flesh coloured quartz-porphyry showing a great similarity to the above named porphyry rocks. — On the N side of the lake a mountain composed of granitite is seen (outcrops in the summit). Boulders of syenite and gabbro-diorite have also been found there.

On the right of Ysuk there is a lava rock containing mostly empty pores. The groundmass is black or brown. Further downward along the river there are rocks of diabase.

At the lower course of Sistikhem, not far from Ust Sistikhem there is a coarse-grained (psammitic) quartzitic sandstone of violet-red colour. A similar sandstone, somewhat more finegrained, occurs further upward along Sistikhem, above the mouth of Tshapsá. Still further up the sandstone passes over into a conglomerate with a psammitic cement and pebbles of quartz. At the mouth of Tshentan there are rocks of a dark grey, slaty kind (tuff?). At Ust Algiak the right side of Sistikhem consists of a porphyroide. This rock is greyish and contains small concretions of quartz.

In the divide between the Sistikhem and Amyl rivers a calciferous and quartzitic sandstone occurs, forming the upper part of the mountain Ottyg-Tasküll. In a somewhat lower locality a gneissic rock appears (basis of the sandstone). The same rock composes also the rocky sides of the Amyl river somewhat below the mouth of Semiretshka.

4) Data communicated by POLETIKA (1860) and referring to the Sources of the Amyl and Sistikhem Rivers (page 11).

In the uppermost course of the Amyl river the boulders consist partly of »greenstone», schists and quartz, partly of granite and of reddish clayish slate, the latter occurring as a cover on the old metamorphic schists in the surrounding mountains. In the torrents Tsherny and Bolshoy Algiak, both joining Sistikhem, boulders of a rock are met with, probably being an alteration product of red clayish slate. Another sediment, a brown-grey sandstone occurs there too, being in parts loose, in parts more quartzitic. This specimen was not noticed on the Amyl river.

The main divide between the head waters of the Uss and the Amyl rivers consists chiefly of granites.

E. The Huakhem Drainage Area.

1) The Huakhem Valley upward from the Mouth of the Baisút River to the Mouth of the Bren River (BACKLUND, FOSLIE).

The lowermost course of Huakhem has already been described in chapter II, entitled »The Central Uriankhai Steppe Area» (pages 73—75) and characterized as belonging to this physiographic province. Upward from Ust Baisút (Baigak or Feodoroffka) the valley gets narrower and the landscape more mountainous. One enters the great wooded mountain region of the Huakhem drainage area.

The first outcrops of rocks at the river's edge above Feodoroffka are of the same coarsegrained granite which occurs at the last named place. Also here the rock is crossed by dikes of basic rocks, getting more gabbroidal and also more rich in amphibole when the breadth of the dikes increases.

Further up the river the granite is the only rock occurring in the mountain slopes reaching to the mouth of the Haptá river. Here a vast delta plain has been formed, with an erosion bluff towards Huakhem. At the edge of the bluffs lies the village Boyaroffka.

On the hillsides to the left of the lower course of the Haptá river an amphibole granite occurs, of the same type as in the above mentioned localities (Baisút-type). When following the right side of Huakhem upstream from Boyaroffka granite may still be observed, partly getting reddish and more acid and showing a prismatic joint-structure. Also pegmatite dikes appear, cut off by more basic granite dikes. Further up the river's edge the trail enters an open river plain, and the valley gets broader. On the plain the village Snamenka is situated.

At the inner edge of this plain there are the mouths of some mountain valleys, eroded in granite terrane. At the mouth of Mergen a coarsegrained diorite occurs. Further up this valley sharply formed summits were seen showing slopes of a backstone red colour (red granite?).

On the right side of Huakhem, opposite the limestone quarry, there is a contact between red and grey granite. Also sedimentary rocks occur, contact-metamorphosed. They are partly cordierite-bearing and micaceous schists, running N 55° E and dipping NW 60°. In the vicinity there is also limestone, further up the slopes as it seems alternating with the schist. Nearer to the mouth of the Tersik river one can observe that the whole series is oriented into the direction N 45° E and dipping NW 55°.

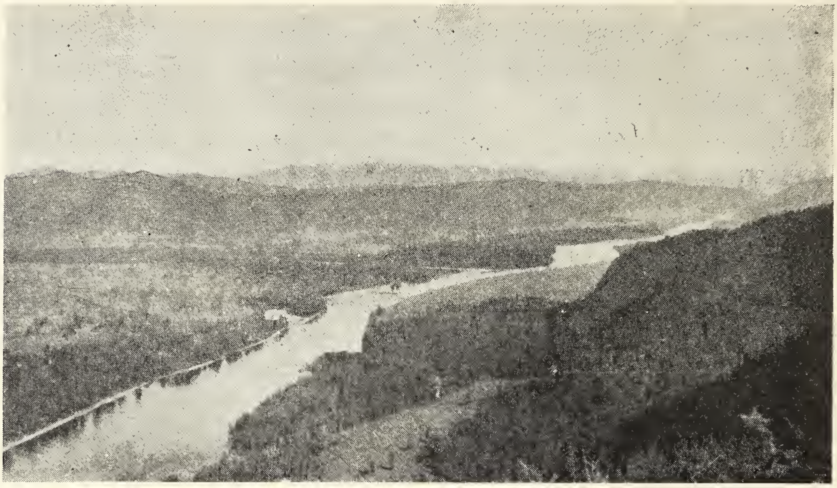

Fig. 31. The Huakhem river valley in its middle course. In the center of the picture mouth of the Tersik river (right tributary). Looking E (upstream).

Photo. St. Foslie.

On the left side of the Huakhem river there is a mountain complex showing various contacts between granite and limestone. The limestone is altered to marble and is quarried. The limestone layers run SW. In the named quarry the marble is cut across by dikes of red aplite. In the vicinity were found loose boulders of magnetite and also of skarn minerals (epidote-diopside-garnet rock). The quarry rock runs N 40° E.

The following specimens were collected from the vicinity of Snamenka (by Foslie):

T. s. 13. Quartzite with pavement-contact str. L. side of Huakhem, 3 versts above Snamenka.

14. Basic variety of diorite. 2 $^1/_2$ versts NE from Snamenka.
T. s. 15. Amphibole diorite. Ibidem.
T. s. 16. Amphibole diorite, more basic. 4 $^1/_2$ versts E from Snamenka, summit of a mountain.
T. s. 17. Basic granodiorite. L. side of Huakhem, 4 v. ab. Snamenka.
T. s. 19. Aplitic granite. L. side of Huakhem, 3 v. ab. Snamenka.

Further up the Huakhem the road crosses the mouth of the Tersik river. The mountain slopes in the lower part of the valley belonging to this river, are still composed of granites, etc., but after passing the village Gryasnúha (Potilitzyn) one enters a porphyry formation, which extends up the Huakhem for quite a long distance. The main types here are greenish and dark brownish nearly dense porphyries.

2) Route of TH. BRENNER: Hlebnikova — Bilbei (upstream) — Baien-gol (Pitchi Bren) (downstream) — upper course of the Bren river (upstream) — Hodyk (upstream) — Shorbluk (downstream) — Shurmak (downstream).

At the mouth of the Bren river in the Huakhem the mountain slopes consist of red Devonian strata. Ab. 10 versts up the Bren valley conglomerate containing pebbles of red sandstone and red quartz-porphyries is met with. The boulders of sandstone disappear 11 versts from the mouth and are replaced by boulders of quartz-porphyries, granites and some basic rocks. One verst further upward on the right side of the valley there are outcrops of red quartz-porphyry showing transitions to a red middlegrained biotitegranite. In some parts the quartz-porphyry is tuff-like and contains lapilli inclusions. The normal type is very similar to the porphyry on the N side of the Huakhem between the rapids and Ust Bren. The granite is porous and easily weathered. Both rocks show very marked joint planes. In the granite there are inclusions of an evengrained diorite; the amphibole in the last named shows elongated forms.

Sp. B. 1a. BRENNER. Diorite, Bren valley, 15 versts fr. the mouth.
» B. 1b » Red granite enclosing fragments of the diorite. Ibidem.

The high mountains to the N of the confluence of Uluk Bilbei are exclusively composed of deepseated igneous rocks. The oldest one is a small grained, grey biotite-amphibole granite with a conspicuous crushed structure. This rock occurs chiefly as greater or smaller inclusions in a surrounding granite, a more coarsegrained amphibole bearing granite, very similar to the Baisút-type. The latest eruption is represented by aplites, probably symmagmatic with the coarsegrained, because they show transitions to the latter. The whole complex is dissected by a diabase dike.

Sp. II. 1a, Brenner. Granite (Baisút-type). N from Ust Uluk Hair.
» II. 1b » Dark, smallgrained granite. Ust Uluk Hair.
» II. 1c » Contact sp. between the two above named. Ibidem.
» II. 1d » Aplitic variety of II. 1a. Ibidem.
» II. 1e » Diabase (dike). Ibidem.

Between the mouths of the Uluk Bilbei and the Uluk Hair on the left side of the main valley there is a series of eruptives, the oldest one being a diorite, appearing in the shape of greater fragments in a smallgrained grey-yellowish granite, which is crossed by dikes and stocks of a partly red, partly grey (?) coarsegrained biotitegranite, showing transitions to aplite. Quartzporphyry appears as well. This is beyond doubt associated with the porphyry formation at Huakhem above Snamienka. At the mouth of the head arm Pitchi Hair, on the left side, a diorite occurs which also changes into amphibolite, finegrained.

The mountains rising to the E of the named mouth are chiefly composed of a typical diorite, small- or middlegrained. In the southern slopes these mountains are composed of red granite, coarse grained and easily weathering, with joint planes.

Sp. II. 2a, Brenner. Sm. grained granite. SE fr. Ust Uluk Hair.
» II. 3a » Red, coarse granite. Uluk Bilbei. R. s.
T. s. » II. 3b » Finegrained diorite. Ibidem.
» II. 4a » Contact betw. II 3a and II 3b.
T. s. » B. 2a » F. grained amphibole-hornfels. Pitchi Hair.

Opposite the mouth of Pitchi Hair, on the left side of Pitchi Bilbei there are outcrops of granite with dioritic inclusions. On the way from the valley up to the divide between Bilbei and Baiengol (Bren-drainage) there are several outcrops of a reddish-grey, finegrained rock of somewhat changing aspect, with a partly porphyritic development, partly a banded appearance. The rock is a kind of hornfels from a contact area between the great batholiths.

T. s. Sp. B. 3a, Brenner. F. grained hornfels. Between Bilbei and Baiengol.
» B. 3b » D:o. Ibidem.

About one verst to the W of the watershed between Bilbei and Baiengol a finegrained diopside hornfels (sp. Br. 1a, T. s., Brenner) occurs, of a somewhat inhomogeneous aspect, partly dioritic, partly amphibolitic. Further westward a pale coloured nearly dense rock of a metamorphosed quartzite appears (sp. Br. 2a, T. s., Brenner) running N 10° E.

Down the Baiengol valley, on its right side, a red granite dominates. It contains inclusions of crystalline limestone, oriented in the direction N—S.

The last named is coarsegrained and carries zones of skarn. To the W the limestone is bordered by a massive of a finegrained diorite, enclosing fragments of the former rock. Also inclusions of a greyish-green quartzprophyry appear in the limestone.

T. s.	Sp.	Br. 4a,	Brenner.	Olivine rock in limestone. Baiengol valley.
T. s.	»	Br. 5a	»	Diorite with fragments of limestone. Ibidem.
	»	Br. 5b	»	Felsite inclusion in diorite. Ibidem.

Down the Baiengol valley to the mouth in the Bren valley (Ust Baiengol) an old quartzporphyry (Sp. Br. 6a, T. s., Brenner) is met with, mostly of greyish -greenish colours and an inhomogeneous aspect. At Ust Baiengol a massive of amphibole-quartz diorite (granodiorite) of grey colour appears (sp. Br. 8a, T. s., Brenner). This rock extends also 3 versts up the Bren valley from Ust Baiengol. At the last named place the granodiorite is crossed by a dike of an aphanitic diabase (sp. Br. 7a, T. s., Brenner). Also fragments of basic rocks are enclosed in the rock (Sp. Br. 8b, Brenner). Somewhat N from the confluence of the Bren and Shurmak rivers there is an outcrop of marble (Sp. Br. 8c, Brenner), S:ward again replaced by the magma rock. But the crystalline limestone reappears, when going upstream. It shows a marked limit against the granodiorite, which at the contact carries some contact minerals (skarn). The limestone, being coarse crystalline (sugar-grained) has no distinct strike. But further up the valley the limestone gets schistose and alternates with a slate (sp. Br. 8d, Brenner). The strike here is constantly N—S. Still further up the valley the slate is the dominating rock and is then crossed by innumerable quartz veins.

T. s.	Sp.	Br. 8e,	Brenner.	Quartzite schist with cordierite. 3 versts S from Ust Baiengol.
T. s.	»	Br. 8f	»	Talc schist. 4 versts S from Ust Baiengol.
	»	Br. 8g	»	Quartz lense in schist. 3 versts S from Ust Baiengol.
T. s.	»	Br. 8h	»	Microgabbro (dike facies). 3 versts S from Ust Baiengol.

The talc schist occurs at the mouth of the tributary Yjyl. To the S from this place limestone appears again and also schists, all penetrated by diorite. Further upstream the valley gets suddenly narrower and the country rocks change into a red granite (sp. Br. 10a, Brenner) quite finegrained and crossed by dikes of aplite and pegmatite. The rock shows horizontal joint planes. Other specimens of red granite are:

	Sp.	Br. 11a,	Brenner.	1 $^1/_2$ verst SE from camp II B. Bren valley.
T. s.	»	Br. 12a	»	S side of the granite barrier, Bren valley, E side.

Through this granite terrane the river flows in many rapids (see fig. 32).

Going further up the same valley one will find the red granite of the same aspect. Here and there aplitic dikes are to be seen. In a broader part of the valley an eruptive contact between the red granite and a diorite can be detected, the former being the younger one and showing at the contact line a quartzporphyric habit. In parts there is a typical breccia, in parts a perfect transition between the two rocks, in other parts the limit is very distinct.

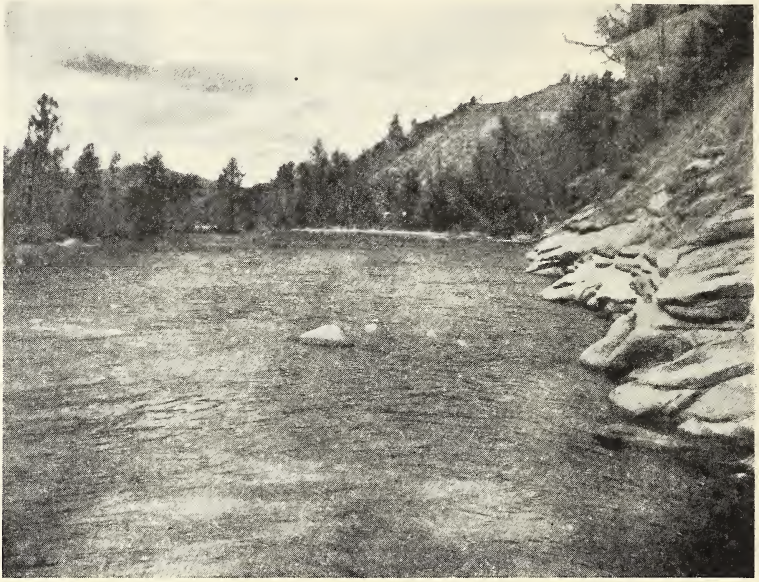

Fig. 32. View of the upper course of the Bren river. The valley is eroded in granite. Looking downstream.

Photo. Th. Brenner.

Sp. Br 12b, Brenner. Diorite, S of the canyon in the red granite, Bren valley.

Further up the valley on the right side there is a schistose basic rock and nearby a highly granitized gabbro-diorite. S:ward the red granite appears again showing rough rock surfaces.

This red granite is no doubt identical with the red granite at Snamenka (Huakhem).

Boulders in the river bed consist of granites, schists, diorites and gabbroes. Also boulders of milkwhite quartz are present (originated from pegmatite dikes in the red granite?).

On the left side of the valley, ab. 1,5 versts to the N from the mouth of Hodyk, there is a schistose, felsitic rock, partly finegrained (sp. Br. 13a, Brenner). The strike of the rock is N 30° E and the dip SE. The rock is highly weathered and falls easily into decay. Smaller lenses of granite appear, lying concordantly to the schistosity.

The Expedition entered the tributary valley Hodyk following it upstream. Ab. 1 verst from the mouth a labradorite porphyrite carrying numerous streaks of lesser basic composition was observed. (Sp. of the porphyrite Br. 14a, Brenner). This rock shows a transition into diabase (sp. Br. 14b, Brenner), finegrained and partly appearing in amphibolite-shaped complexes, in some parts of a more acid habit. Locally there is a schistosity with orientation N—S. Here are also injected parts of grey granite, showing a more basic composition against the contacts. Absorption-like transitions could be studied.

Sp. Br. 14c, Brenner. Mingled rock. Hodyk valley.
» Br. 14d » Granite (syenite?) with smaller fragments of a basic rock. Hodyk valley.
» Br. 14e » Inclusion (?) in granite. Hodyk valley.
» Br. 15a » Gabbroidal rock. Hodyk valley.

Further up the Hodyk valley there is again the red granite, coarsegrained, in a typical development. The jointing and weathering of the rock are the same as in above named localities. This type dominates up to the valley head.

After crossing the watershed between the Hodyk and the Shurmak valleys, the Expedition entered the little head arm of the latter, Shorbluk. In this creek the red granite is still to be seen, some times with smaller aplitic dikes. The coarsegrained structure of the granite and its uniform habit seem to indicate, that this part is one of the more central ones of the batholith.

Further down this valley the granite carries inclusions of diabase of quite large sizes and isolatedly swimming in the former rock.

Following the Shurmak valley downward the Expedition noted the presence of the same granite, which in the E slopes (right side of the valley) carries again inclusions of diabase, this rock being sometimes of dioritic aspect. The inclusions have sharply defined contours. Further down the valley there is a gabbro alternating with diabase and with the coarsegrained granite. Then follows only diabase, in parts of a porphyritic development.

Ab. 3 versts from the farm Skobeieva on the Shurmak there are floor outcrops of a grey granite in the valley (sp. Sh. 1a, Brenner) and a boss of a reddish-grey granite, corresponding to the above mentioned red type. The light coloured (reddish) granite forms distinct dikes in the grey one. Both varieties show inclusions of darker types (assimilated diabase?) with transitions into the surrounding rock.

Sp. Sh. 1b, BRENNER. Biotite granite. 3 versts SW from the farm SKOBEIEVA.
» Sh. 1c » Lighter variety of the granite. Ibidem.

1,5 versts N:ward from the farm the grey granite outcrops carrying fragments of diabase.

2 versts N from the farm the red granite is met with, here being of a quartz-porphyric development. It shows a clear transition into a tuffite and a dense quartz-porphyry. The tuffite has joint planes, directed N 25° W and dipping steeply E.

Sp. Sh. 2a, BRENNER. Well developed quartzporphyry. 1,5 versts N from the farm SKOBEIEVA.

Further down on the right hand of the Shurmak river, in the direction of Vladimiroffka there is only quartzporphyry, in some parts of a coarser, granitic development. The hill ridges rise continuously toward the E.

3) Route n:o 1 of STEINAR FOSLIE: Hlebnikova—Ust Bilbei—Ust Sidzim—Sidzim (upstream) - Dshivei (downstream)—Huakhem—Ust Ushep—Ushep (upstream)—Karasuk—Idyk mountain—Karadsharyk—Shuy—Huakhem—Hlebnikova (cfr. the itinerary Map n:o 3).

From Hlebnikova the left side of the Huakhem valley was followed upstream. Already at the mouth of the Bilbei river (left tributary) the Devonian sandstone disappears, and quartzporphyries are met with. These form the basement of the Devonian. The porphyries are generally of red colours and show phenocrysts of quartz and feldspar (regarding the rocks in the vicinity of Hlebnikova see ST. FOSLIE: page 132).

Ab. 7 versts up the Huakhem valley from Ust Bilbei a red, coarsegrained granite is met with. It seems to be closely related with the quartzporphyry, because there are structural transitions between the two kinds of rocks.

At Ust Sidzim (Huakhem valley) there is again the red granite (sp. 21,T. s., FOSLIE), showing in parts a semi-porphyric development. At this locality there are marked terrace lines, the highest one lying approximately 35 m above the river bed.

In the mountain rising S 30° E from the mouth of Sidzim the red granite appears again (sp. 22, T. s., FOSLIE). Near to the summit the granite is crossed by a dike of finegrained diabase with small amygdules (sp. 20, T. s., FOSLIE).

Then the Expedition followed the Sidzim valley upstream along its right side. In the river gravels there are pebbles principally of red granite, but also of quartzporphyry, gabbro, green amphibolite schist and some quartz. Further upstream the valley gets narrower and the country rock all the way is the red granite up to 27 versts from Ust Sidzim. Here an older, dark porphyry rock is met with. The contact line against the granite runs half way between the camps III and IV. The porphyry shows a quite varying habit. Small phenocrysts of feldspar are generally present, and the rock can probably be classified as a felsitic quartz-porphyry. This rock can, however, be well distinguished from the red and brown porphyry forming the basement of the Devonian at Hlebnikova. In one locality the porphyry gets distinctly schistose with strike N 40° E and a vertical dip. Some small lenses of a breccaited, metamorphic limestone are also visible.

Sp. 23, Foslie. Diabase. Dike in granite. Camp III. Sidzim.
» 24 » Dark gneissic rock. N from camp IV. »
» 25 » Dense, dark siliceous schist. Above camp IV. Sidzim.
» 26 » Psammitic, foliated rock. Ibidem.

The age relations between the granite and the porphyry cannot be exactly determined here, but the porphyry is probably the older rock. In the river gravels there are pebbles of a red, coarsegrained granite, finegrained grey granite, quartzporphyry, gabbro, quartzite and some of a white vein-quartz.

Further up the valley the composition of the bedrocks gets more varied. The porphyries disappear, and are replaced by a quite basic abyssal rock, differentiated into a finegrained femic, and a coarsegrained salic variety (sp. 27, Foslie). The latter penetrates the former and forms a kind of breccia with it. Both these varities are crossed by irregularily oriented dikes of red aplite (sp. 29, Foslie). The dikes cut also a finegrained, dark, in parts schistose and streaky lava like rock. The last named carries some small strongly folded inclusions of a brecciated limestone. In the same complex there is a small area of a coarsegrained granite and a larger one of a typical gabbro, showing transitions between a finegrained and a coarsegrained facies. Aplite dikes are also to be seen here.

Sp. 30, Foslie. Biotite granite. Above camp IV. Sidzim.
» 31 » Greenstone, finegrained. Ibidem.

In places, where the gabbro has a parallel structure, the structural planes run N 45° E, and the aplite dikes strike then concordantly.

Further up the Sidzim valley a complex is met with consisting of strongly folded biotite gneiss penetrated by a grey granite, middlegrained and of massive habit. This type is identical with the so called Baisút granite. The injection can be intensified so as to form a migmatite, showing transitions into homogeneous granite of greater extension.

T. s. Sp. 32, Foslie. Epidote amphibolite (?). Above camp IV, Sidzim.
» 33 » Middlegrained gabbroidal rock. Ibidem.
» 34 » Finegrained facies of former. Ibidem.
» 35 » Gneissic granite. Above camp V, Sidzim.
» 36 » Basic schist. Below camp VI, Sidzim.
» 37 » Chlorite-hornblende schist. Sidzim, upper course.
» 39 » Hornblende schist, alternating with coarsegrained hornblende gabbro. Above camp VI, Sidzim.

Further up the Sidzim valley there is still the gneissic rock reaching to a point above the camp V, where the rock is so intensely granitized, that the granite gradually becomes the dominating member. The strike of the gneiss seems to be principally N 75° E, and the dip is steeply to the N. Local foldings cause, however, many disturbances. Somewhat further up the valley, where the head rivers of Sidzim join one another, the Baisút granite is the dominating type. It is greyish-yellow and coarsegrained.

The Expedition followed then the right head arm of Sidzim upward. At first there is only the mentioned granite, but 2,7 versts from the mouth a typical mica schist is met with carrying some purely quartzitic interstratifications. This rock runs N 40° E and dips 75° SE. It is quite well laminated and without granitic dikes, but with numerous quartz veins of small extensions. In the mountain sides N from the valley this rock strikes N 60° E and dips steeply SE. Some of the layers in the rock are hornblende bearing, others rich in quartz. In one locality a hornblende schist appears, in parts folded.

T. s. Sp. 40. Foslie. Two mica schist, partly quartzitic. Head river of Sidzim.
T. s. » 37 » Hornblende schist. Ibidem.

Side by side with the hornblende schist there is a purely quartzitic layer of minimum breadth 30 m. This complex runs N 55° E and dips vertically.

Then the Expedition turned back to the side valley which joins Sidzim 7 versts further northward, and followed it upward in E:ly direction over to the Dshivei valley.

At the mouth of the tributary valley there is a granite, but soon E:ward it is replaced by a hornblende gabbro (sp. 40a, T. s., Foslie), quite coarsegrained, nearly pegmatitic, which penetrates a schistose rock of the same kind, partly dark, partly with light bands and also injected by granite. The limit between the schistose and the massive gabbro is quite distinct, and both these rocks are crossed by a pale coloured aplite and by veins of quartz.

Further up the little valley there is still the hornblende gabbro showing a streaky and changing aspect. After passing 2 versts one enters an area of migmatite, which soon gradually changes into a pure granite.

Sp. 43, FOSLIE. Hornblende gabbro. Sidzim tributary ab. camp IV.

The granite is here somewhat pressed and carries spots of biotite. It shows a similarity with the Baisút type, which appears at the mouth of the same valley. This granite continues further upward in the mountains (divide between the Sidzim and Dshivei valleys), here and there with narrower belts of hornblende schist (inclusions). Also a finegrained gabbro in the shape of dikes was met with.

From the summits of the divide there is an imposing view southward of the Tangnu-Ūla mountains with their snow clad alpine peaks lying at the sources of the Dshivei rivers.

The northern slope of the divide mountain consists of the same granite. Further northward, in a valley leading into Sidzim, there is a typically red, coarsegrained granite, identical with the same at the lower course of Sidzim.

In the divide mountains there is also the red granite, somewhat miarolitically developed. In the slopes toward the Dshivei valley the same granite appears, until just before the camp VII a diorite is met with.

When resuming the geological relations in this region it may be stated that the red granite is younger than the Baisút granite and that the difference in age may be quite important, when considering the existence of a broad, finegrained contact facies in the red granite against the other. Except the youngest basic dikes, all basic eruptives seem to be connected with the older granite only, partly consanguineous, partly as inclusions.

In the N slope of the valley which descends to Dshivei, there is a coarsegrained diorite intensely intersected by dikes of granite aplite. Nearer to the camp VIII one enters a hornblende granite area crossed by sharply limited dikes of diabase, often with small apophyses into the granite.

The hornblende granite extends down to the broad valley of Dshivei.

The gravel train in the named valley is of considerable thickness. The pebbles in the gravels consist of granite and gabbro, the former coarsegrained, and of labradorite and feldspar porphyries.

Down the Dshivei valley, on the right side, a streaky diorite outcrops, quite coarsegrained. It is crossed by irregular masses of a coarsegrained, yellowish-grey granite. Both these rocks are intersected in various directions by narrow dikes of a red, aplite granite. All the named rocks are in their order crossed by a dike of diabase porphyrite. In the higher slopes granite aplite dominates. Further down the valley there is only a typical red granite, coarsegrained.

The mountain slopes to the E from the farm Blinova in the lower part of the Dshivei valley are in their lower parts composed of coarsegrained granite, probably of the red (younger) type. This rock is crossed by an at least 20 m broad diabase dike, this generally of coarse grain, due to the great dimensions. Only the »salband» shows a fine grain, the structure being partly of porphyritic development. The dike encloses fragments of a coarsegrained granite. There are also many thinner diabase dikes. Further up the mountain slopes a red granite appears, somewhat more finegrained than the same at Sidzim.

	Sp.	41,	Foslie.	Hornblende biotite granite. Camp XVII. Uluk Dshivei.
	»	42	»	Coarsegrained hornblende diorite (basic). Camp VII. Uluk Dshivei.
	»	43	»	Granite type. Side valley at camp IV, Sidzim.
	»	44	»	Porphyry rock. Above camp IV, Sidzim.
	»	45	»	Dense limestone. Ibidem.
	»	46	»	Smallgrained red granite. Divide between Sidzim and Dshivei.
	»	47	»	Dike of finegr. granite crossing coarsegr. granite. Camp VII. Uluk Dshivei.
	»	48	»	Lost.
	»	49	»	Finegrained porphyrite dike (in granite). At the camp VII. Uluk Dshivei.
	»	50	»	Finegrained granite. Ibidem.
	»	54	»	Granite type. Ab. camp VII. Ibidem.
	»	56	»	Diabase dike in granite. Camp VIII. Uluk Dshivei.
	»	57	»	Contact between granite and aphanitic diabase. Ibidem.
	»	59	»	Finegrained granite. I v. ab. the farm Blinova. Uluk Dshivei.
T. s.	»	60	»	Granite. Upper part of Uluk Dshivei.
	»	61	»	Granite. Uluk Dshivei.
	»	62	»	Diorite, crossed by red granite. 10 versts above the farm Blinova. Uluk Dshivei.
	»	63	»	Finegrained contact facies of the diabase dike ag. the granite. Farm Blinova.
	»	64	»	Aplitic granite as dike in diorite. 10 versts ab. the farm Blinova.
	»	65	»	Diabase type from the big dike. Farm Blinova.
	»	66	»	Gabbroidal rock. Dike in granite. Ibidem.

Further down the Uluk Dshivei valley nearer to Huakhem the bedrock is generally hidden. Some outcrops consist of coarsegrained, dioritic rock, further down of the red, coarse granite, which last named dominates down to Ust

Dshivei. On the left side of the Huakhem valley just above Ust Dshivei the red granite changes with a paler coloured diorite, showing leukocratic dikes.

In the opposite side of the Huakhem valley a typical, coarsegrained granite of the Baisút type outcrops.

On the same side of the valley, just opposite the mouth of Dshivei a quaternary basaltic lava appears, resting over the sand sediments of the valley floor as a mighty bank (cfr. H. Backlund).

A study of the pebbles in the recent gravels at Ust Ushep proved the presence of a slaggy labradorite porphyrite with numerous small feldspar laths, scarce felsite porphyry, some coarsegrained dioritic eruptives, some quartz and a pebble of an agglomerate (sp. 68, Foslie) apparently from some Devonian beds.

At Ust Ushep the Huakhem river enters a »Water gap», which crosses a mountain barrier in many rapids.

The mountain slopes in the vicinity of Ust Ushep are on both sides of the Huakhem valley composed exclusively of granite, from some distance quite uniform looking. On a closer study of the rock, one observes that the red granite without any distinct limits changes with the grey, granodioritic type, occurring here. A banded alternation between these two types produces often a gneissic habit (sp. 69, Foslie).

T. s. Sp. 70, Foslie. Red grainite. Ust Ushep.
» 71 » Breccia betw. finegr. basic eruptive and red granite. Ibidem.
» 72 » Olivine diabase (?) Opp. Ust Dshivei.
T. s. » 73 » Basalt dike crossing granite. Ust Ushep.
» 74 » Breccia changing into spot granite. Ibidem.
T. s. » 75 » Diorite, biotite bearing. Ust Ushep.

At Ust Ushep there are also breccia-shaped, mingled rocks: sharply limited fragments of a finegrained basic rock lying in the red granite. These breccias show also transitions into a spot granite.

The granodioritic modification at Ust Ushep can either be a primary differentiation product of the granite magma, or represents an older type, or resorbed inclusions. Just above the farm Gorbunova the granite is crossed by a diabase dike.

Up the Usep valley a grey quartz-dioritic rock was first met with. The river flows here in a canyon like gorge, which, however, soon gets broader upward. The bedrock consists here of a pale coloured yellowish grey, coarsegrained granite, carrying some inclusions of a gabbro rock.

Then the Expedition mounted a steep slope toward the W. The bedrock here is a light coloured granite and gabbro. Then a divide was crossed and the

Karasúk valley entered. On the way there only granite was seen, in all parts very coarsegrained, but of various colours (red, yellowish-grey, grey). At a right head arm of Karasúk a pale coloured, very coarsegrained granite of greater extension outcrops. Further westward, up to the Idyk Mountain there follows a gneiss, a streaky and folded arterite. This rock can be followed down to the Karadsharyk valley. Granitic material is to be seen quite often in this gneiss and also quartz veins. Strike and dip are too varying as to permit any measurements.

Down in the Karadsharyk valley the bedrock consists of a grey, middlegrained biotite granite.

From this locality via the Shuy valley down to the Huakhem valley no geological observations were made.

Then the Huakhem valley was followed downstream through a terrane of typical red granite extending to Ust Sidzim, then through a quartz-porphyry ground until the Devonian area at Hlebnikova was reached.

4) The Devonian Terrane at Hlebnikova (Huakhem). (With a geological Map fig. 34). By STEINAR FOSLIE.

During a stay in Hlebnikova (the base of the Expedition) situated at the inner edge of a sharp bend of the river Huakhem some miles from Bielotzarsk upstream, the author got an occasion to take up in the last week of August 1917 a detailed study of the geological relations in the mentioned locality. As a base to this study served a little topographical map, made by the author in the scale 1: 50,000, covering a area of ab. 40 km^2. After the completion of this map the geological study was begun, but soon stopped again, because it became necessary to continue the ordinary work of the Expedition, this mapping being only of interim character. The last named thus never got finished.

In spite of the fact that many questions referring to the area at Hlebnikova still are unsolved, the author thinks that a communication of the observations made may be of some interest, because they are the most complete from this part of the country.

The series of layers of entirely unmetamorphosed character and never folded, comprising sandstones, conglomerates and limestones, which appears at Hlebnikova, is entitled »Devonian». There are, however, no fossils found in this series up to the present time, and the name Devonian is thence of entirely conventional character.

In every case this assumption seems to be quite well founded regarding the minute similarity with the well known sedimentary rocks in the Minussinsk basin, regarding the petrographical composition as well as the geological position. In the Minussinsk basin the series begins with the middle Devonian sandstones, being the oldest nonmetamorphic rocks in the district, and ends with the lower Carboniferous.

In the Uriankhai basin, separated from the foregoing by the older metamorphic rocks of the Sayan Mountains, a similar series of sediments is met with, where the existence of Devonian as well as Carboniferous has been proved. This extensive terrane of continuous sediments gets toward the east and south more and more dissected by faults and is dissolved into a number of isolated smaller terrane-remnants. The occurrence at Hlebnikova has some interest in the sense, that it is the easternmost and southernmost remnant of this formation known in the district.

In every part where the sandstone terrane at Hlebnikova is not limited by faults, but the basement of the same can be observed, the latter consists of a mighty formation of red quartzporphyries. This fact can be proved along the whole northern limit, crossed by the course of the Huakhem river 3 versts above and 5 versts below Hlebnikova and likewise in the gravel covered peninsula, formed by the bend of the river.

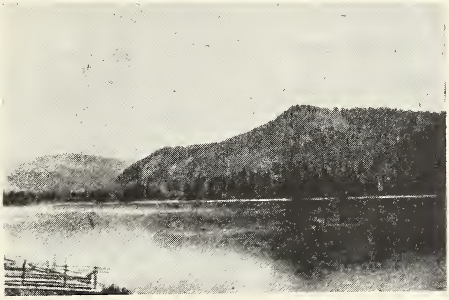

Fig. 33. Left side of Huakhem opposite Hlebnikova. Sandstone mountain lying at the mouth of Bilbei (extreme left of the picture). Looking SE. *Photo. E. Lindén.*

The quartz-porphyry is a very common rock above as well as below the Devonian terrane. The principal mass of the rock is red coloured, containing abundant quartz phenocrysts. There are also some parts of a different type with greyish groundmass and intensely red pigmented phenocrysts of potash feldspar. There is generally no conspicuous banking, but in isolated areas one observes tuffs, well stratified, and occasionally agglomerates.

When going up the Huakhem river from the Devonian terrane, one finds, that the quartz-porphyry gradually changes to a semi-porphyric granite and at last to a red granite with a normal structure of an abyssal igneous rock, the last named of a great extension. There can be no doubt about the closer genetic relation between the granite and the quartz-porphyry. The gradual transition between them gives an impression of a direct connexion without any difference in age.

The first question to be answered is, if the sandstone is sedimented subsequently to the formation of the quartz-porphyry, or if there may be any hiatus of upheaval and erosion. In every place, where the basement can be observed, it consists of quartz-porphyry. On the other hand there are near the base in some separate arcose like layers consisting of non triturated weathering-gravels, not only fragments of quartz-porphyry, but also of the red abyssal granite. Likewise one meets higher up in the strata in conglomerates pebbles of quartz-porphyry side by side with pebbles of the typical red granite. It seems therefore without doubt, that the abyssal granite has been laid bare by the erosion already before the sedimentation of the sandstone took place.

Now we may look nearer at the sucession of the strata in the terrane under consideration. The lowermost layers are best exposed in the river side 5 versts below Hlebnikova, without, however, any visible basis. The last named outcrops in a distance of 300 m from this place, being quartz-porphyry. The quartz-porphyry shows here a distinct banking with a dip of 20° toward S 35° W (all observations magnetical). The lowermost visible sandstone dips here also 20° toward S 35° W, and there is no doubt, that we have here a normal overlap. If the series of strata begins with a basal conglomerate or not, can not be determined here. In the lowermost part of the series there are, however, thinner conglomeratic seams alternating with the normal sandstone layers, or more correctly, very coarse arcose, without any rounded pebbles. The arcose consists of an unweathered, rough detritus from a red coarsegrained granite, of some quartz-porphyry and of a few soft flags of clayish slate. The fragments are sometimes of a size, which allows the rocks to be easily determined (recognized) and they cannot have been transported a long way. In the sandstone there are also some thinner layers showing transition into clayish slate. The sandstone is partly pure, partly filled with flags of the same reddish slate, here and there also with fragments of granite. Upward in the series a throughout uniform sandstone seems to dominate.

When following the river upstream from Hlebnikova one approaches again the basement of the Devonian series. 3 versts in this direction the quartz-porphyry is met with. The basal layers are here, however, likewise not visible, and the sandstone shows everywhere its uniform habit without any arcose layers in the corresponding horizon as below Hlebnikova.

The principal mass of the sandstone series, the lower part of which is exposed on the northern river side, the higher part appearing in the steep mountain slopes of semicircular shape on the southern side, is very uniform. It is an even-grained, and red coloured and nearly everywhere crossbedded sandstone.

Quite isolated thinner, clayish layers appear. Thus on the southern side of the river, SW from Hlebnikova, a layer of 5 cm thickness comes in sight, consisting of a highly pelitic, red, clayish slate, very persistent in the direction of the strike and sharply separated from the crossbedded sandstone. The rock should be an excellent medium for fossils, but none were found. Suncracks are, however, a common feature. In the nearest lying part of the hanging sandstone (20 cm) there are numerous fragments and flags of clayish slate. On both sides from this layer the sandstone has a white fade aspect in a zone of 1,5 cm thickness, this due to action of circulating water.

The first variation in this uniformly shaped series is to be found quite high up in the profile, where a sheet of basalt appears. It is not possible to estimate more exactly the thickness of the sandstone up to the lava bed, before the faults of the area have been studied in detail. If there is not an important fault in the profile, which could have altered the original thickness, the last named could be ab. 800 m. As a minimum thickness 300 m could be stated, which is found in a continuous profile (steep slope), where the layers alternate one with another regularly. The former measure is, however, the more probable.

The basalt bed has been observed in the mountain slope to the W, S and SE from Hlebnikova, with a quite uniform dip, ab. 10° S, 30°—40° W and on heights over the river, indicating, that the bed cannot be downfaulted to any considerable degree. The rock is an amygduloid basalt, of ab. 10 m thickness. The vesiculae are filled with calcite.

In this connection it can be mentioned, that in the river gravels of the right tributary to Huakhem, Tersik (joining the last named ab. 20 versts further downstream) curious small nuggets of native copper have been washed out. The origin of these may be an amygduloid rock occurring very probably in another terrane of the same Devonian basalt bed.

The hanging sediments to the basalt bed are of different character. While the underlying series is practically free from carbonaceous matter, the overlying one includes limestones and also sandstones, arcoses and conglomerates all conspicuously calciferous. The succession of strata above the basalt bed is as follows downward:

20—30	meters	Sandstone, downward slightly, upward markedly calciferous and including some thinner arcose like layers.
7—8	»	Limestone, sharply limited from the former, often intensely red pigmented, partly of a grey colour, quite usually sandy. A very characteristical feature are patches of a red calcedonian quartz. — This limestone represents the highest horizon in the profile SE from Hlebnikova.
1—4	»	Arcose with calcite groundmass, the last named sometimes with an uniform optical orientation in larger individuals.
5	»	Relatively coarse conglomerate with calciferous cement. The boulders are generally angular and consist of red sandstone,

	dense limestone, some quartzporphyry etc. but also of rounded, strange pebbles. This is the highest horizon in the mountain profile SW from Hlebnikova.
1 meters	Calciferous arcose, showing transition into
1,5 »	dense massive, partly red coloured, impure limestone with some thinner seams of arcose.
1,5 »	Red lime-sandstone with a few conglomerate layers.
5 »	Typical conglomerate with calciferous cement. This conglomerate is very polymixed, principally with pebbles from the underlying rocks: quartz and feldspar porphyry, fine-and coarsegrained red granite, sandstone and dense grey limestone. These pebbles are apparently slightly rounded and often angular and generally of very reduced sizes. They never attain the size of a fist but on the other hand they decrease in size as to form a kind of coarsegrained arcose. Besides there are some well rounded pebbles of strange rocks, chiefly gabbro, amphibolite and grey granite.
2 »	Arcose-like sandstone, still visible. To this horizon reaches the profile in the steep mountain slope W from Hlebnikova.

We have thus here a series of 55 m thickness of calciferous sediments. Further upward in the mountain slope (above the profile) the rocks are hidden, but still further upward in the plateau-like mountain there is a relatively mighty series of coarse, partly arcose-like sandstone, which is no longer red, but grey and to some degree calciferous. This series represents certainly a still higher horizon, and with a dip of 10°—15° WSW it can be followed until it westward is cut off by faults.

If we follow the series toward SW, we pass through the layers in an inverse succession: limestone, conglomerate, limestone and mighty underlying sandstone, this time with a dip 65° E. Below the sandstone we pass directly into red granite, coarsegrained, partly semi-porphyric, but without any quartzporphyry.

We can with certainty suppose the presence of great faults here, running ab. NNW, but they cannot immediately be observed, because they are hidden beneath the soil. There are, however, some small faults with a displacement amount of 1 m. The steeply upturned series of layers could be explained as a flexure against a great fault wall, but it seems more probable that it is a block, on both sides limited by faults. The fact that a coarsegrained granite forms the basement of the series in question, does not demand any faults here. As above was stated, the granite has been laid bare by erosion in some localities already before the sedimentation of the Devonian series began.

Morphologically there is a striking contrast between the broad plains on the northern side (inside the big bend of the river) covered with a thick layer of river gravels, and the steep, roughly cut mountain slopes along the river course on its southern side. It is evident, that Huakhem cuts its way in a great swing through the soft Devonian layers and gradually migrates southward. It is also apparent, that there may have been a sudden upheaval in quite recent times to an amount of at least 10 m. In its present course the river has cut down through its own gravel deposits and moreover into the firm bedrock of the basement. That this upheaval may have occurred relatively rapidly, is seen from the fact, that the river has cut its bed vertically. That the upheaval is of quite recent date, will be illustrated by the lack of adjustment of the erosion of some small side valleys, which have their mouths at the upper edge of the 10 m high cliff along the river.

The rapids in the river just above Hlebnikova are to be found at the place, where Huakhem leaves the hard quartzporphyry area above the Devonian area and enters the latter.

Kristiania, february 1922.

Appendix: geological map of the Hlebnikova region (cfr. fig. 34).

ROCK SPECIMENS FROM THE VICINITY OF HLEBNIKOVA collected by STEINAR FOSLIE.

Sp. 81. Red granite, porphyrically developed. Huakhem, opposite Hlebnikova.
» 82. Red granite, finegrained var. of the foregoing. Ibidem.
» 83. Red granite, finegrained, at the limit of the Devonian area. Ibidem.
» 85. Conglomerate with fragments of a brown porphyry, etc. and a calciferous cement. Top of the Devonian profile at Hlebnikova.
» 79. Brown arcose with calciferous cement. Layer above the limestone horizon. Hlebnikova profile.
» 80. Brown, dense limestone. Upper part of the Dev. profile. Ibidem.
» 84. Dense limestone. Upper part of the Dev. profile. Ibidem.
» 76. Amygduloid basalt sheet (upper part). Devonian profile at Hlebnikova.
» 78. Evengrained basalt in the Dev. profile, lower part. Ibidem.
» 77. Arcose, bottom layer in the Dev. profile. Ibidem.
» 77a. Brown arcose, bottom layer in the Dev. 5 versts below Hlebnikova, on the river.

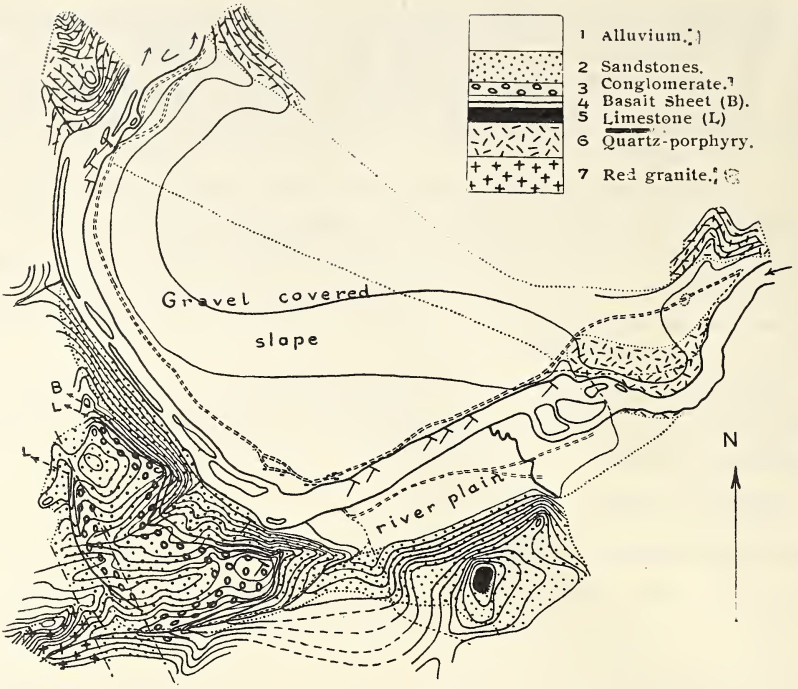

Fig. 34. The Devonian Area at the Bend of Huakhem, Hlebnikova.
Scale 1:100,000. *By St. Foslie.*

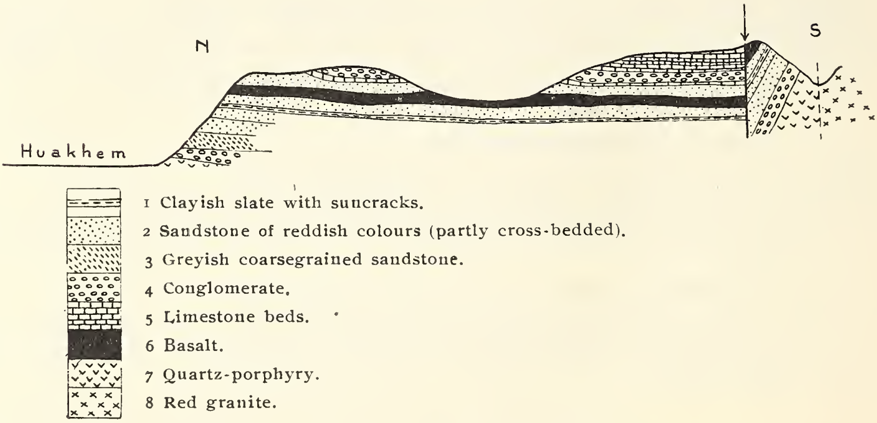
N
S
Huakhem
1 Clayish slate with suncracks.
2 Sandstone of reddish colours (partly cross-bedded).
3 Greyish coarsegrained sandstone.
4 Conglomerate.
5 Limestone beds.
6 Basalt.
7 Quartz-porphyry.
8 Red granite.

Fig. 35. Idealized section through the Devonian Terrane at Hlebnikova.
By H. Backlund.

5) Route of J. J. SEDERHOLM: Hlebnikova—Yershey—Karadsharyk—Tshaima—Kunduskuduruk (downstream)—Bolshoy Ushep (upstream)—Hongysh Mountains—Kara Ushep (downstream)—Kunduskuduruk (upstream)—Shuy—Shevelik—Tersik (downstream)—Potilitzyn—Hlebnikova (cfr. the itinerary Map n:o 2).

From Hlebnikova the Huakhem was followed upward along the right side at the foot of the steep porphyry cliffs. When approaching the mouth of the little torrent Yershey, one observes that the porphyry gets more granitic. The last named type shows the same jointings as the porphyry. On the left slope of the named stream the dominant type is, however, a grey biotite granite. It contains numerous, partly large inclusions of a mica schist, transformed into arterite.

Just to the E of the mouth of the Yershey, where the Soyot camp is situated, there appears in the even slope (toward Huakhem) a terrace-like ribbon, consisting of a blistery olivine basalt (sp. 24, T. s., SEDERHOLM) grey in colour and with rel. large empty cavities. The mentioned lava bed has a thickness of 10 to 15 m and rests on granite ground, ab. 10 m above the level of the Huakhem. The lava edge reaches ab. 1 verst up the river and seems always to be of the same thickness. Where the lava ends in the E, the underlying ground is red granite with a porphyrically developed structure.

At the lowermost rapids in the Huakhem the rock ground consists of granite, crossed by several dikes of a dark grey, finegrained amphibole porphyrite (sp. 25a, T. s., SEDERHOLM). The dikes are often only some cm thick, but finer ramifications of a nearly dense and black felsite appear as well (sp. 25b, T. s., SEDERHOLM).

Further up the Huakhem valley, on the right side, the trail ascends a mountain slope, consisting in its upper part of a partly blistery, grey lava. When going further E:ward, one finds, that the lava is replaced by red granite, which may be the basement of the lava here. Reaching the valley of the Shuy, grey gneiss-granite is met with, which also composes the mountain sides to the E from the river. In the Karadsharyk valley the gneiss-granite is very schistose, partly penetrated by small aplite dikes (or arteres).

Going NE from the camp on the Karadsharyk the bedrock consists of a pale coloured, at first evengrained granite, further on (upward in the Idyk Mountain) of reddish porphyric granite (sp. 27, SEDERHOLM).

The following course was taken over the sources of the Tshaima river to the Kunduskuduruk valley. On the watershed crossed before reaching the last named there is granite to be seen at first, then, in the very crest a basic schistose rock with an inhomogeneous habit and numerous streaks of epidote and quartz.

Also veins of quartz are seen, containing greater individuals of epidote. In some parts the rock shows a resemblance to a tuff (sp. 28, Sederholm).

In the small creeks leading down to the Kunduskuduruk valley there are numerous boulders of a grey granite and of a gneissic schist. The former has been intruded into the latter, partly as to form a kind of arterite partly whole eruptive breccias.

In the Kunduskuduruk valley there are boulders of grey granite and of a red quartz-porphyry. The mountain sides to the N from the washing works of Voronin in the named valley consist of limestone, partly very pure, partly of banded appearance (sp. 28a, 28b, T. s., Sederholm). The strike is here N 10°—25° E, the dip 80°—90° E.

Just above the washing works of Bielousoff in the same valley appear on the N side outcrops of a basic schist running N 25° E and dipping ESE 75°. The rock is cut across by a grey granite.

The Kunduskuduruk valley was followed downward to the Bolshoy Ushep valley. Then the Expedition climbed along the latter upstream. One verst to the N from the mouth of the Kunduskuduruk there are high mountain slopes consisting of »schists», running N 50°—60° E and dipping 80°—90° SE. Somewhat further upward a dark slaty limestone occurs (sp. 29, T. s., Sederholm).

Where the Kuk-Tash joins the main river, there are outcrops of a dark schist rock (sp. 31, T. s., Sederholm) with a distinct stratification. The orientation is N 32° E and the dip SE 70°. In the high mountains to the NE from the last named locality there are everywhere »dark schists» containing numerous veins of quartz, which sometimes reach a thickness of some meters. The strike here is N 55° E, the dip 65° SE (also N 70° W?). Further up the Ushep valley there are the same kinds of schists, but here running N 70° W (?) with a dip S 85°. In the torrent bed (Ushep) are many boulders of quartz-porphyry. Also a boulder of a blistery basalt was seen. Further up the river a grey granite dominates. The same rock occurs also at the confluence of Bolshoy and Malyi Ushep (sp. 32, T. s., Sederholm).

Further upward in the torrent bed of B. Ushep above the junction with Malyi Ushep the boulders consist chiefly of grey granite. The same rocks form also the mountain sides here.

From B. Ushep the Expedition followed a little creek, Oruk-tuk-khem SW:-ward and ascended the Hongysh Mountains. In the vicinity of the timber line the bedrock consists of a fine grained quartzite (sp. 33, T. s., Sederholm) crossed by a network of fine cracks later on cemented. Further upward the quartzite seems to be penetrated by an eruptive (diorite porphyrite? Sp. 34, Sederholm, is lost) showing transitions to granitic types.

On the NE side of the Hongysh complex the quartzite is crossed by dikes of a quartz-porphyry with a finegrained groundmass (sp. 35a, T. s., 35b, T. s., SEDERHOLM), but also by an amphibole bearing diorite porphyrite (sp. 35c, T. s., SEDERHOLM) of a somewhat darker colour. These types are doubtless of the same origin.

In the SE part of the Hongysh Mountains there is again quartzite, associated with mica schist. Veins of quartz are seen. Further S:ward the quartzite is replaced by diorite and more granitic types. Then the Expedition followed a little creek leading down to the Kandyk (?) river. The bedrock is here mostly diorite, showing transitions to gabbro and still more basic varieties. Further down the named creek, where it joins the left head-arm of the Kandyk, there are boulders and pebbles of a great variety of rocks. The dominant type is a diorite, associated with more basic members, or even an amphibole-fels (sp. 36a, 36b, 36c, SEDERHOLM).

In the Kandyk valley there is chiefly diorite, S:ward getting more granitic. (A coarse grained type is shown in sp. 37, T. s., SEDERHOLM). — In the vicinity of the sources of the May river the dominant rock is a diorite and continues also farther up the upper Kara Ushep valley, changing here into an amphibole-biotite granite (sp. 38, T. s., SEDERHOLM) of a dark greyish colour. Down in the valley the bedrock consists of diorite and quartzite, the latter running N 45° E, in one place also N 10° E. The dip is steeply NW. Following the valley further downward one observes alternating parts of diorite and quartzitic schists. Some versts above the mouth in the B. Ushep there is a finegrained mica schist, running N 70° W and vertically tilted. The main rock is, however, still diorite. It is very inhomogeneous and banded, and has a nearly migmatitic aspect. When approaching the mouth of Kara Ushep in B. Ushep one observes, that the dominating rock is now the quartzite schist. In the torrent bed of the B. Ushep there is a conspicuous quantity of boulders of red granite and quartz-porphyry, both completely absent in the tributary valley just passed. Some versts to the N from the mouth of the named valley, the sides of the main valley consist of schist, running N 65° W and dipping steeply NE (sp. 39a, SEDERHOLM, is lost). The rock is crossed by dikes of a grey, fine grained diorite (sp. 39b, T. s., SEDERHOLM). N:ward the schist gets a still more typical mica schist, finegrained. The rock is in part clearly stratified (banded), but here are also other types such as quartzitic schists. Veins of quartz are numerous. Reaching the mouth of the Kunduskuduruk valley, the Expedition followed the last named upward, then it passed across the upper part of the Tshaima valley and the sources of the Shuy valley. In the last named region the dominant rock is a diorite.

Then the Expedition crossed a watershed and followed the Shevelik valley, a head arm to Tersik. Along the former and also along the Tersik valley the main rock is a red granite (sp. 41, SEDERHOLM) jointed into flat lying banks. It shows an intrusive contact at the diorite. In the Tersik valley there are boulders of an aplitic, red granite (sp. 42, T. s., SEDERHOLM). Further down the Tersik valley diorite again appears.

6) Route of H. G. BACKLUND: Hlebnikova—Huakhem (upstream)—Shuy—Idyk Mt—Tshaima (downstream)— Ushep (downstream)—Ust Ushep—Huakhem (upstream) — a point some versts below the confluence of Huakhem and Shishkit—sources of the Kunudius river — Left head arms of the Unshei river (cross-route)—sources of Unshei—sources of Kongi—E slopes of the Hongysh Mountains—right arm of Kongi—May river (downstream)—Huakhem (downstream)—Hlebnikova (cfr. the itinerary Map n:o 2).

Above Hlebnikova, where the lowermost »porogs» (rapids) of Huakhem appear, the river cuts across a barrier, consisting of quartz-porphyry. This rock is sometimes darker and more dense, in other parts paler red and megascopically grained, then showing transitions to a red aplitic granite, which is similar to the red aplite, occurring further down the river at Alexeieffka (where a grey granite comes into contact with limestone-slates). The N slope of the gap mentioned consists of a talus of quartzporphyry débris, while the S side of the river shows steep cliffs of the same rock. In the small and flat rock surfaces at the river's edge there are alternating stripes of dense and grained rock. The jointing of the porphyry is columnar in a regular manner (somewhat parallelipipedic) resulting in an intense decay of the rock. On the S side of the river the porphyry is of a more effusive habit especially in the S slope of the mountain gap used by the river. The type here may be of a real surface habit.

In the upper part of the river gap more deepseated parts of the porphyry formation seem to be exposed, because a red aplitic granite, connected with the porphyry, appears. To the E the extension of there rocks is apparently determined by faults.

In the Yershey porog the bed-rock consists of a reddish granite, in some parts pegmatitic. Dikes of a basic, nearly black, grained feldspar-carrying rock appear in a parallel arrangement, dissecting the granite. The orientation of these dikes is N 10° E, and the dip is 80° E.

In the N side of the Huakhem valley at the mouth of the little stream Yershey there is a step, consisting of basalt and lying on an old river terrace ab. 10 m above the river level. The thickness of the lava is ab. 12 m. The base of the basalt bed is hidden by rock débris. The middle part of the bedd consists of a dense, the upper part of a blistery type showing also flow structure, indicating a former direction of movement N 80° W. The upper surface of the basalt bed is ab. 0,5 verst in breadth and seems to terminate N:ward, where a grey granite with inclusions of a dark (cordierite-) schist appears. The lava bed seems to rest partly on the firm bedrock (granite), partly on old river gravels and may thus be of Quaternary age.

In the E rises the Idyk Mountain, the S spurs of which are crossed by Huakhem between the mouths of Ushep and Karasuk. In the W the mountain mass is dissected by the valley gorge of Shuy and also by many other narrow valley gorges causing a quite rough erosion topography draining into Huakhem. In general the Idyk Mountain is, however, very little dissected by erosion. It reaches hardly above the timber line.

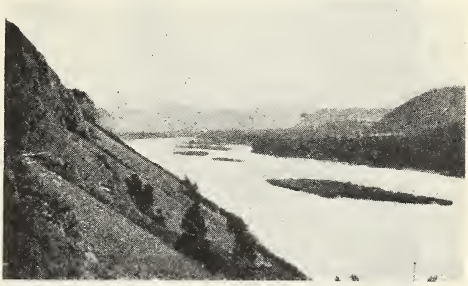

Fig. 36. Huakhem river above Hlebnikova. The slopes in the foreground consist of porphyry.
Photo. Th. Brenner.

The mountain consists of a core of grey granite, being in parts quite poor in quartz and even quartz free. Especial y in the NE part of the mountain the last named type is the dominant, showing a pale coloured weathering crust, and reminding much of alcaline rocks. In S and SW directions a quartz-poor, grey, amphibole-bearing granite dominates, to some degree with parallel structure. Where it comes into contact with the former type, it is crossed by pale coloured, nearly white aplite dikes, running E:ward. The contact line runs N—S—SE. The amphibole granite, in some parts being rather granodioritic, reaches down to the edge of the river (Huakhem), forming here the steep S slope of the Idyk Mountain. In the NW, to the N from the western head arm of the Karadsharyk it has a parallel structure, is quite abundantly quartz-bearing, and of a more gneissic character. It encloses fragments of amphibolite schist. This mixture is straightly crossed by dikes of aplite. The mountain ridge to the W from the Shuy valley consists of red granite, being without doubt younger than the former.

To the W of Ust Shuy, ab. 300 m above the level of Huakhem there is a basalt bed of ab. 30—40 m thickness, thinning out to the N. The S edge rests on a quite loose gravel-conglomerate, the N on red granite (?). The basalt is blistery, in its upper part even nearly slaggy, but without any secondary minerals in the vesicles. The rock shows a great similarity with the above described basalt at Yershey but it is evident, that it is of greater age, representing a terrace remnant of a lava flow in the Huakhem valley, when the bottom of the latter was (relatively) 300 m higher than now. Remnants of an old erosion level are seen in the Huakhem gorge in the form of a terrace-line just to the W from the Ust Karasuk, marked by a shelf or ruins of a shelf, lying on the limit between the rock débris on the lower slopes and the undulating upland surface. If remnants of a basalt bed are present here also, could not be proved. A terrace line is also met with at the mouth of Karasuk on a lower level, no doubt corresponding to the lava-flow phase at the mouth of Yershey.

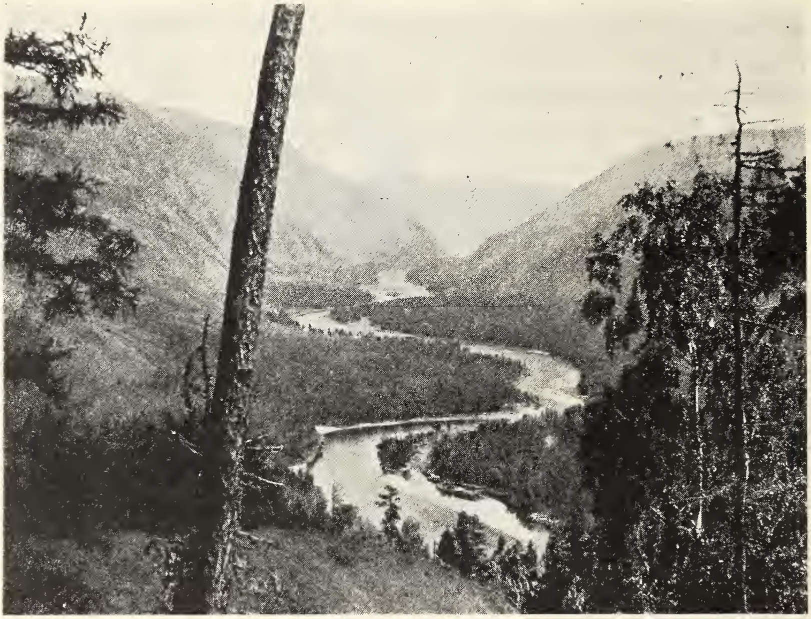

Fig. 37. The Huakhem valley upward from Ust Shuy. Note the typical mountain character of the valley. The meandering is due to mountain slides and torrential fans. Looking E
Photo. H. Backlund.

When following the Huakhem valley further upstream and leaving the gorge, one meets with terrace remnants of high position, lying at the right side of the valley, both below and above the mouth of Ushep (see the itinerary map n:o 2, BACKLUND). Somewhat to the E of the mouth of Dshivei (see the map) the S side of the main valley is bordered by a discontinuous ribbon of basalt, reaching upstream at least to the confluence of Huakhem and Shishkit (further on the valleys were not surveyed). The œquidistance between the rivers surface and the lava-ribbon increases steadily upstream, a fact indicating either, that the ancient lava stream which filled out the former valley bottom had a greater gradient than that of the present river, or that the amount of elevation has been greater in the E. The former alternative seems, however, less probable, because the terrace formation, corresponding to the lava flows, indicates the presence of a very slow gradient at that time, while the assumption of an oblique elevation (= tilting increasing eastward) stands in accordance with the observators experiences in the North-Siberian vulcanology.

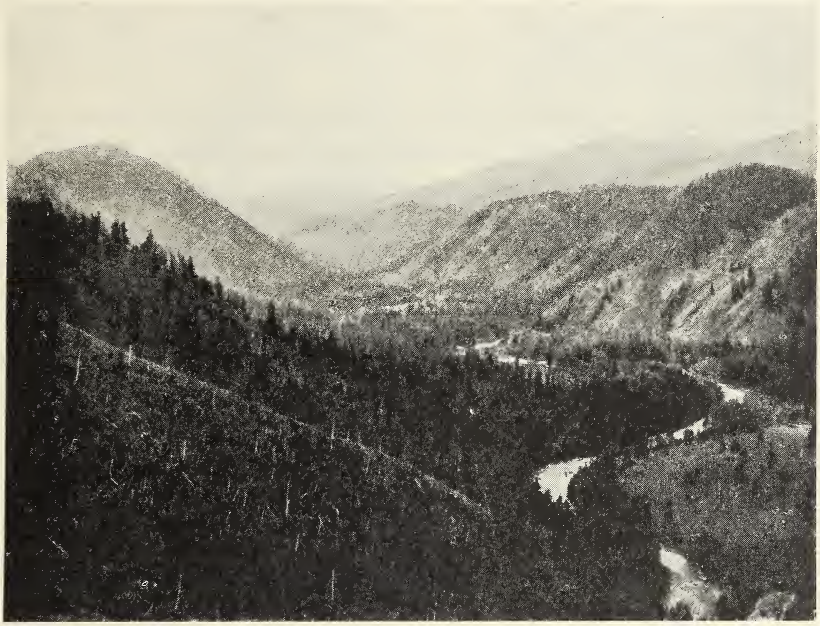

Fig. 38. Lower course of the Ushep valley below the mouth of Tshaima (right tributary). Looking downstream (S).

Photo. H. Backlund.

The lava ribbon along the S side of the Huakhem valley has its correspondency in the N walls only in scattered places where mouths of tributaries are situated and smaller erosion-remnants of the lava have been preserved.

The alkaline rocks of the Idyk Mountain seem not to continue far to the N, because the heavy boulders in the N sides of the same consist of grey granite, partly carrying biotite, partly very finegrained and with parallel arrangement of the components. The whole drainage basin of Tshaima lies thus in the massive of the named granite. In the Tshaima valley this rock is crossed by dikes of aplite, very rich in quartz and occurring ab. 3 versts above the confluence of the twin head-rivers of the named valley. The dikes appear also in the mountain ridges between Shuy and Tshaima. The aplite shows a peculiar structure with rounded quartz pseudo-pebbles, containing a core of feldspar.

Below the junction of the two head arms the main valley soon gets narrower in a V:shaped profile. The main rock is here a pale grey biotite granite, downstream getting darker and amphibole-bearing, in parts even dioritic. The side valleys have a hanging character. Small remnants of old terrace plains are to be seen, lying ab. 10 m over the valley floor.

The gorge character of the Tshaima valley dominates down to the mouth in the Ushep valley. The last named was followed downstream to Huakhem. The profile of this valley is more open, although the walls are high (see the fig. 38). The valley floor is flat and the river runs in a meandering course over it.

At the mouth of Tshaima the dominating rock is granite, coarsegrained with great biotite flags and containing inclusions of basic rocks, partly resorbed by assimilation. The rock is crossed by diabase dikes, running N 40° W.

The valley floor of Ushep has a considerable gradient toward Huakhem, as shown already by the rapidly flowing river. The gravels are mostly composed of great boulders, nearly exclusively of granite, to a small degree of crystalline schists, penetrated by veinlets of granitic material.

The granite in the valley wall is often penetrated by dikes of basic rocks, the broader ones being of a more gabbroidal character.

In the lower part of the valley the river has carved out a young bed in its former deposits, the latter appearing as a conspicuous terrace on the left side of the river. The plane of the terrace corresponds to a rock barrier at the mouth of Ushep, now cut across by later erosion, producing a narrow gorge. The lava ribbon at Ust Ushep, above mentioned, corresponds to the named barrier.

Regarding the lava it appears as two beds, the lower one ab. 8 m thick and comparatively little olivine bearing, while the upper is a typical olivine basalt (cfr. the lava at Ust Yershey). The two beds are sharply divided one from another by a blistery horizon of lava. The height of the base of the lava over the rivers edge is ab. 20 m. The whole length of the terrace remnant above Ust Ushep is 2 versts. The lava rests on granite of a pale greyish type, crossed by dikes of a dioritic rock.

Further upward along the Huakhem valley the last named gets a more canyon-like shape for some distance. The main rock here is a red, coarsegrained, somewhat porphyric granite. It shows a jointing into great parallelipipedical blocks, a phenomenon never observed in the terrane occupied by the grey granite. The nearer relations between the two kinds of granite were not studied. The red granite like the grey one is crossed by dioritic dikes.

Somewhat below the mouth of the Lower May river the red granite is again replaced by the grey one (when going upstream), outcropping in the low rock surfaces on a flood plain there. At the E end of this last named the valley gets again narrower and a cape of grey granite extends directly into the water. In this place the granite shows an abundance of inclusions, giving to the rock a »Schlieren»-habit. There is also a transition to arterite-like mingled types. The intruded rock was originally a mica schist, which has been transformed into arterite or into a cordierite-fels-like contact type, in which the parallel structure is marked by secondary stripes of quartz. The rock mixture has undergone a strong micro-folding. By closer investigation it was found that the granite has invaded a complex of mica-schist and gneiss, enclosing large fragments of these rocks. Their general strike is N 20°—22° E and dip SE 75°—85°. The described mixed rocks can be followed upward along the Huakhem valley to a point somewhat to the E from the mouth of the Upper May river.

The mouth of the Kongi river is a narrow canyon-like gorge between steep walls of granite with columnar jointing. The valley is hanging in relation to Huakhem. The delta fan at the mouth is to a greater part composed of boulders and pebbles of basalt, although this rock seems to be absent in the surrounding mountain sides. Other boulders in the gravel fan consist of silicified limestone grey and dark (fossiliferous!), and of grey granite and injection-gneiss.

Further up the Huakhem valley, above the mouth of Kongi there is a narrowing of the valley profile. When leaving this passage (upward) one observes that the slopes are marked with conspicuous terrace lines. One terrace lies 10 m over the rivers edge, another 8 m higher. The latter lies on granite.

The basalt ribbon following the S wall of the Huakhem valley upstream from the vicinity of Ust Ushep is intersected ab. 1,5 versts above Ust Kongi and appears again at the western side of a broader side valley, where Tarbagatai joins the main river. The lava ribbon is crossed by the named tributary stream in a narrow gorge.

Above Ust Tarbagatai the main valley gets again narrower, and the river flows in rapids as generally in such water gaps. Further upward there is a conspicuous river terrace in the N wall of the Huakhem valley, lying ab. 30 m above the water level.

The mouth of the Unshei river is also canyon like (young cut in a hanging valley floor) and the firm rock here consists of grey granite jointing into mighty beds. On both sides of the mouth smaller remnants of lava are to be seen in the usual form of high seated ribbons. On the W side of the mouth the ribbon has an extension of only ab. 100 m, on the east side there is a terrace-like streak of the same basalt, extending at least 2 versts upward along Huakhem. This bank has a thickness of ab. 35 m. The gravel fan at Ust Unshei consists almost only of pebbles and boulders of basalt, while in the gravels of Huakhem just above the named mouth, granites are the dominant kinds of rocks.

Ab. 3 versts above Ust Unshei another narrow passage of the main river occurs being, however, of short length. After passing the gorge upward a dike of pegmatite of 20 m thickness and oriented N 30° E is met with.

Further upward the grey granite still dominates, but shows a great number of basic inclusions, partly banded by fine intrusions and even partially remelted. The inclusions attain sometimes also greater dimensions and are then of schist character.

Nearer to the confluence of Huakhem and Shishkit the river valley gets narrower again and has many difficult passages. In the high slopes to the N the granite contains numerous inclusions of schists. 13 and 17 versts above Ust Unshei there are smaller remnants of basalt terraces, lying 40 m resp. 80 m above the rivers edge. In the latter locality the lava bed has a thickness of 45 m.

Along the S wall of the Huakhem valley the lava ribbon stretches quite continuously upward from Ust Unshei. An interruption occurs at a locality 14—15 versts from Ust Unshei. At the latter place the lava bank lies at a valley mouth, probably identical with Khargin-gol. The tributary has cut across the barrier in a gorge. 20 versts above Ust Unshei the lava ribbon is also met with in the N wall of the main valley. Upstream the height of the lava ribbon above the river's edge increases continuously, and likewise the thickness of the lava, when going in the same direction (this circumstance can probably be explained by recurrence of lava flows).

Some versts below the confluence of Huakhem and Shishkit the Expedition turned northward up a side valley to Huakhem, and reached the sources of the Kunudius river, the latter evidently a tributary to Shishkit.

Up the slopes northward from Huakhem in the direction of Kunudius the bedrock consists of the same granite, which is partly more aplitic, but contains also basic dikes. In the highest divide between Huakhem and Kunudius (700 m ab. the former river) a finegrained, palecoloured granite outcrops. From the named divide one gets a wide panorama view E:ward (direction of Kossogól), SE and S (Tangnu-Ūla). Reaching the S wall of the upper Kunudius valley, one meets with a great mass of granite boulders. The gravel in the bottom of the named valley consists chiefly of quartz, granite, gneisses, mica schists and basic rocks.

A cross-section of this part of the valley is broadly V:formed, but downward it soon gets narrower (gorge shaped). The main rock types in the surroundings of upper Kunudius are mica schist of different aspect, with quartz lenses and penetrated by aplitic granite. In the S slopes the general strike of the schist is N 32°—52° W and the dip 41°—75° SW, in the N slopes steeply NE. The intensity of the granite intrusion increases toward S and SW, indicating that the intrusive basement (the batholith) appears in the said directions. In the opposite direction (to the N) again, a mica schist becomes the dominating rock, a fact indicated by the great frequency of pebbles and boulders of the named rock in all the creeks, following the slopes from the N. — On the S side of the Kunudius valley the mica schist is crossed by dikes of basic rocks of a mica-dioritic and even a gabbroidal character. They are younger than the granite and aplites.

To the N, far above the forest-covered slopes there are (10 versts distant) summits with some glacial cirques, being, however, of insignificant dimensions.

In the head region of Kunudius, on the N side of the main valley, there is a conspicuous transition from a steep dip (35° NE) to a more flat position of the mica schist when going N:ward. The intrusion of the aplite has to a considerable degree disturbed the original strike of the rock, and a parallel arrangement to the borders of the intrusion bodies can be observed, as in a locality at the confluence of the two head arms of Kunudius, where the general strike of the schist is N 60° W and the dip 51° SW.

The watershed between Kunudius and the E head arm of Unshei consists of micaceous, gneissic rocks. To the S they pass over to mica schists, folded in detail. Here the strike is N 48° W and the dip 45° SW. This dip is produced by repeated isoclinal micro-folding. In the folded mica schist there are lenses of a coarse crystalline limestone (somewhat dolomitic and wollastonite bearing), markedly schistose. The orientation of the rock is N 12° W and the dip 28° SW. One of these lenses has a thickness of 12 m. The limestone occurs also in alternating bands with biotite gneiss, the last named reminding of schistose basic intrusive sheets. At the contact line between the limestone and the gneiss the former is serpentine bearing with a tendency to form eozoon-like figures. The mica schist, jointed parallel with the schist planes of the limestone, is feldspar bearing in the immediate vicinity of the latter.

The mountain torrents, descending the slopes toward SW from the crest N from the sources of Kunudius and joining further down the Unshei river, flow all in broad upland valleys, somewhat marshy and with flat outcrops of the bedrock here and there. In the valley bottoms there are often greater boulders of gneiss and granite, reminding of erratics. The heads of these valleys are cirque-formed with steep sides, to some degree of the appearance of real glacial cirques or »Kaare». No moraine ridges are to be seen. The confluence-channel of all these upland valleys is a narrow, V:shaped one, representing the result of a more recent erosion.

In the vicinity of the above named valley heads the bedrock consists of a gneiss of various aspect, partly of a quartz-striped kind showing a gradual transition into a more massive type, which is characterized by a predominance of chlorite and scarceness of secondary quartz, and reminding then of a greenstone. In other localities the feldspar-quartz constituent grows more abundant and the rock reminds of a granite gneiss, cordierite bearing, passing over to a fine grained rock of quartzporphyry habit. In the named series of types there are also basic intrusive rocks of a dioritic and gabbroidal character, but they have been transformed into amphibolitic and skarn varieties. In some parts there are outcrops of a finegrained, pale coloured rock of granitic character, but its relations to the surrounding rocks are unknown. All the petrographic variations can be well studied in the boulders of the valley bottoms in the vicinity, offerring a real sample collection of the average geological composition of the mountains.

The whole complex described shows a metamorphic habit of a higher degree, than ever observed by BACKLUND in any part of Uriankhai including the Sayan schist.-area. The abundance of granitic varieties, showing partly parallel arrangement of the structure near to the gneisses, indicates that the bottom-batholith is not very far. In one locality (camp 15—16/VIII) lying in the high mountain region, there is an outcrop of a coarsegrained granite, which also partly composes the boulders. This granite carries numerous inclusions of rounded fragments of schists and dense, basic rocks (reminding of conglomerate pebbles). The rock is also dotted with numerous aggregates and bulbs of blue cordierite and grey quartz. These are crossed by dikes of aplite, showing a transition to the surrounding rock. The intrusion contact phenomena are in general of an abyssal habit with intense resorption of the gneissic rocks. The limit between the granite and the gneiss-terranes seems to run ab. NW. Greater inclusions of gneiss occur, however, in the granite as well.

In NE direction from the above named camp, 8—10 versts distant there are several rounded summits, showing glacial cirques in the SW-facing slopes. These are forelaid by moraine ridges, which disturb to some degree the old drainage.

The uppermost course of Unshei, traversed by the Expedition, is a canyon like gorge lying in granite terrane, which shows a varying composition. Partly there is a hornblende granite, partly a more dioritic type, enclosing fragments of a mica gneiss, but dissected by dikes of pale coloured aplitic, eugranitic or even basic rocks. The dark coloured chief rock is quite strongly deformed showing gliding planes and partially even schistosity. In the steep wall of the gorge it is of course difficult to determine what type of rock dominates.

The whole dividing ridge between the upper parts of the Unshei and Kongi valleys seems to consist of granite with smaller or larger inclusions of gneiss. The granite is partly of dark colour with somewhat crushed feldspar individuals, partly it is pale garnet bearing, showing a nearly white weathering crust. The latter type penetrates the former in dikes. In the crest line the dark type contains numerous inclusions of gneiss fragments and partially resorbed mica- and cordierite masses. This rock is crossed by dikes of basic types, lacking in the paler variety.

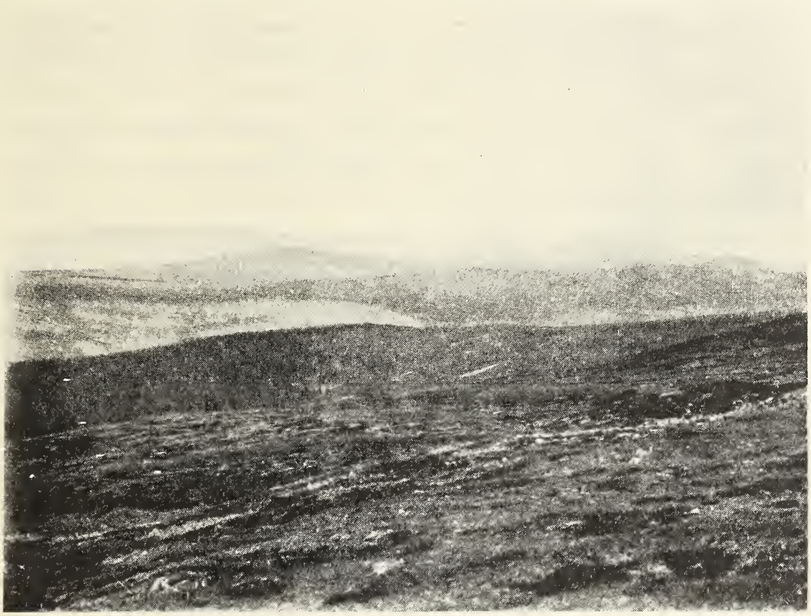

Fig. 39. An outlook over the upland surfaces at the right head arm of the Kongi river (above the timber line). The N spurs of the Hongysh Mountains in camp 22—23/VIII (route of BACKLUND).

Photo. H. Backlund.

The rounded summits (»Goltzy») are generally crowned by ruinshaped weathering-forms of granite, standing out through the cover of débris.

The upper part of the Kongi valley is contrarily to the Unshei open and broad and the gradient is not very steep. In the torrent bed there is a great quantity of boulders, increasing in number downward. In the same direction the valley gets narrower. The main rock is granite, pale greyish, rich in quartz and also hornblende bearing. It is the youngest rock. It encloses often large rounded fragments of a dioritic rock, which in some parts is the dominating one. Both types contain inclusions of gneiss of various size.

2,5 km to the NW from camp 20—21/VIII a cordieritegneiss outcrops, penetrated by a pale greyish granite. On a closer examination of the gneiss complex, it is evident that a basal conglomerate of it has been injected by granite in such a way that the cement has been replaced by granitic material, the pebbles thus being surrounded by granite. The pebbles consist of a dark dioritic rock, and other types, showing a resemblance to a conglomerate lying on the limit between granite and gneiss (mica schist) at camp 15—16/VIII.

To the S and W there follows a granite, partly finegrained. Further W:-ward a large field of boulders occurs, always consisting of quartzite. This rock is coarsegrained, glassy and of a bluish colour. The side rock seems to be partly a schist, containing a basic recrystallized magma rock, partly a pale coloured granite. The nearer relations could not be studied, because the solid rock is almost hidden beneath huge masses of boulders and even by vegetation. A mountain pass NW from camp 20—21/VIII lies in a quartzite terrane, the main rock being here of a similar type as before but of varying colour. The whole S slope of the flat topped mountain to the N from camp 22—23/VIII seems to consist of quartzite too, while boulders of granite were encountered at the camp and in a valley to the E of the same.

Boulders of quartzite were met with also half a verst W from the last named camp, here associated with a grey schist rock. The slopes down to the broad valley W from the camp are loaded with boulders of granite. Nearer to the valley bottom some knobs rise consisting of a mica bearing gabbro-rock. This last named rock is very tough, and the intense jointings produce a decay into polyedrical pieces. The gabbro is penetrated by veins of quartz and even by dikes of aplite granite. At the edge of the torrent bed there are rocks of quartzite, penetrated by gabbro, the last named rock occurring also as boulders in the slopes of the western valley wall. Further upward the same slope the gabbro is replaced by granite, the latter being the older one. In the N spurs of the Hongysh Mountains there is a dike of gabbro in the granite terrane (?).

The great valley running in S direction between camp 22—23/VIII and the Hongysh Mountains has a broad U:shaped transverse profile with a flat bottom, pebble loaded. Over the gravels some knobs of bedrock rise which consist at least partly of gabbro.

The northernmost of the side valleys, descending from the Hongysh Mountains, shows at the mouth (1,5 verst upward) a bedrock consisting of glassy quartzite intensely penetrated by a finegrained hornblende granite. A similar rock of streaky appearance occurs 0,5 verst to the S from this point. The two southward following creeks draining the E slopes of Hongysh down to the broad valley (the right head arm of Kongi) originate in broad valley heads, reminding of glacial cirques. Huge boulders lie scattered irregularily over the valley floor and in the uppermost part of the last named there are also masses of unstratified gravels. But accumulations of doubtless glacial origin are not to be seen.

On a nearer study of these accumulations it is evident that they are still in a stage of seasonal transportation, because the timber trunks standing in the gravel are free from bark on the upward facing side up to $^1/_2$ or 1 m above the gravel surface, and many trunks are broken off at the same heights. This transport is partly due to a solifluction, partly to the formation of gliding surfaces on underground ice further downward. The intensity of this movement was probably greater at a former time of moister climate (the Quaternary period?). The »cirques» above mentioned may thus perhaps be regarded as a result not only of glaciers, but also of a solifluction on a greater scale.

While in the N parts of the Hongysh Mountain quartzites are the dominant rocks, partly penetrated by hornblende granites and gabbroidal rocks, the S facing slopes are composed of a series of alternating quartzites and phyllitic schists, the latter with dark, calciferous interstratifications passing over to dark, slaty limestones. The general strike is NW and WNW, the dip NE and NNE 40°—60°. In the series there are concordant sheets of a gabbro rock transformed into amphibolite, but besides one can observe partly concordant, partly crosscutting dikes of paler or darker porphyrites (effusives?), indicating a probably higher level of intrusion.

The S summit and its spurs to SE consist of these rocks. On the E side of the Kongi valley there seems to be a continuation of the series in question judging from the presence of pale coloured quartzite strata, appearing as winding streaks in the mountain sides here. Numerous boulders of granite even high above the timber line bear witness to the fact that also granite intrusions occur on higher levels. The vicinity of the abyssal rock to the sedimentary series above characterized may be explained by recent fault-movements.

Passing down the smooth-sloping mountain side from camp 23—24/VIII in SSE direction one meets with outcrops of gabbro (2 $^1/_2$ km distant). The bedrock is nearly hidden beneath a débris of rocks, consisting partly of phyllitic schist, partly of hornblendeporphyrite. The gabbro has a great resemblance to the type occurring in the NE spurs of the Hongysh Mountains. It forms the wall of the valley in the E, leading down to Kongi but also the wall of another valley in the W, belonging to the May river system.

8 versts N from camp 24—25/VIII a grey granite is met with reminding of the dominant type at Huakhem. Further down the mountain sides to Huakhem the named granite is the dominating rock, in parts somewhat streaky and containing inclusions of some basic rocks. Smaller occurrences of red granite are also to be seen.

Following the valley downward from the named camp, one observes that the cross-section goes through the granite terrane in many places. The valley is a lower tributary to the lower Kongi.

When leaving this valley and going over to the May river in SW direction, one enters a broad upland valley, ab. 150 m above the level of the Huakhem. The floor of the former corresponds to the level of the younger »terrace»-basalt occurring at the latter river. When approaching Huakhem, one finds that the broad valley changes into a gorge with steep gradient leading down to the main river.

7) Geological Synopsis of the Area N of Huakhem and E of Ushep (cfr. the itinerary Map n:o 2). By H. G. BACKLUND.

The area in question is in general a granite terrane. The dominant (andesinic) granite type is a grey one, crossed sometimes by younger basic dike rocks, in some localities forming independent smaller necks of gabbroidal composition (NE and E of Hongysh). Also pale coloured attendant aplitic dikes are met with in the granite, but their principal occurrences are, however, restricted to areas where the granite shows intrusive contact to sedimentary schists of greater age. The mineralogical composition of the granite shows great variations in accordance with the regional assimilation of partly sedimentary, partly older intrusive rocks of hornblendedioritic to gabbroidal character. A younger red (potassic) granite although of predevonian age seems to play a smaller rôle in the SW corner of the map.

Inside this great granite terrane there are two different areas of sedimentary rocks, quite well limited against S and SW. One of them comprises the northeastern part of the surveyed area and continues probably up to the crest of Ogarkha-Ūla, the other one builds up the Hongysh Mountains and is crossed by the middle course of the river Kongi. If these different sedimentary complexes really have any connexion in the region of the middle course of the Unshei river, has not been proved by field observations. The strike of the schists is in both areas quite the same, NW—WNW:-

ly. In the NE:ern complex the strike is, however, clearly more to the N, in the western complex more W:ly.

The NE:ern complex consists of highly crystalline mica schists, gneisses, partly cordierite-bearing and also coarsegrained white, crystalline limestones, all with steep dip angles. They are crossed by aplitic dikes with quartz and by basic, finegrained dikes. The intrusion phenomena and the high crystallinity bear witness to a deep geological horizon. No bottom of this formation has been found. In all localities where the contact line between the crystalline schist series and the granite could be observed, the latter always showed an intrusive behaviour to the schists. Conglomeratic schists with pebbles of basic diorite appear, however, at the upper course of the Unshei and the Kongi rivers, and are intruded by the main granite, which demonstrates that a basic diorite a. o. forms the basement of the schist formation.

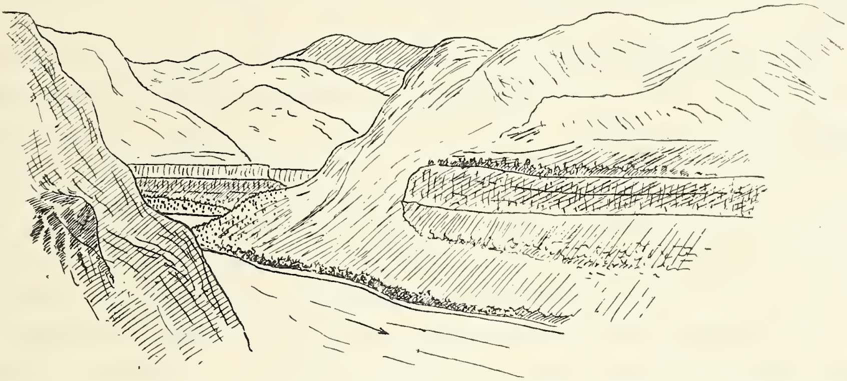

Fig. 40. High situated terrace-like remnants of basalt valley flows in the Huakhem river valley. Picture taken towards the E somewhat above the mouth of Unshei. (Reproduced after an original-sketch of BACKLUND).

While in the surrounding granite terrane many greater and smaller schist bodies are met with, and also fragments of these, having a petrographical similarity with the well limited schist terrane in the northeastern part of the region, it is hardly probable that any greater faults have affected the region. In some localities these isolated bodies of schists show a strike different from that of the closed schist area.

The western schist terrane (Hongysh Mountains and surrounding grounds) is in general composed by phyllitic schists and dark, nearly dense limestones with interstratifications of amphibolitic rocks. This complex shows lesser dip angles than the former gneiss-formation. A prominent member of this series represents quartzites of glassy habit. They seem to correspond to a lower etage of this formation. This latter as a whole shows a lower degree of crystallinity than the foregoing area. It is significant that the younger intrusion in this body has a much lesser marked abyssal habit, in parts a nearly effusive character. Only one part of the quartzite shows a clear relation to the deep seated rocks of granite and gabbro-character (N part of the Hongysh Mountains), the latter being the younger ones. A coarsegrained, conglomeratic quartzite layer seems to form the deepest horizon of this sedimentary formation. The presence of an intrusive contact and deep seated rocks on the same geological level, such as but little altered limestones and phyllites, indicates that this formation is limited by faults of different amount of vertical movement, and that faults inside the complex have brought different parts of it to the same level.

The surface forms in the northeastern corner of the district outside the route of travel have been influenced by veritable glacial sculpture, while adjacent areas southward, down into the forested regions, likewise show broad U:shaped valleys of glacial habit. In spite of the fact that numerous erratic boulders of large size are to be found there, no other indications seem to speak, however, in favour of a glacial origin of these valleys. Accumulations, which could be interpreted as moraines, are completely lacking. It seems more probable, that the formation of these valleys, originated in preglacial times, is due principally to solifluction in Quaternary times. Also underground ice sheets have facilitated the transportation of débris on the slopes to a considerable amount, a phenomenon which can be studied also in the present time. The lower limit of the Quaternary solifluction is indicated by a zone of large boulders, which descends farther downward following rather the bottom of the broad valleys than those of the smaller creeks; this zone is scarcely developed on steeper slopes and in ravines, i. e. outside the principal ways of drainage. This boulder-zone is situated far below the timber line.

Below the U:shaped valleys there are smaller V:shaped ones with relatively strong fall leading down to broad grass grown, sometimes swampy trains, which in their order by way of narrow and steep gorges communicate with the Huakhem river bed. The relative height of these trains over the Huakhem increases towards the east. They mark probably a stage of the main valley erosion, when the latest basalts broke out. The trains consist of fine stratified sand, which probably is an outwash product from the solifluction area nearby on the upper slopes.

8) Route n:o 2 of STEINAR FOSLIE: Hlebnikova—Uluk Dshivei—Haptagai—Khargin gol—Terinūr (Terikul)—Kuria—upper course of Khargingol—Kha-gol—Bokhúr—northern Crest of Tangnu-Ula the same way back to Hlebnikova (cfr. the itinerary Map n:o 3).

The Expedition followed the same track as the first time up the Sidzim valley. From there the watershed in the E was crossed and the valley of Uluk Dshivei was reached just at the farm Blinova. In the first 3—4 versts along the ridge, followed up from Sidzim to the divide, one observes the red granite, in lower regions often crossed by diabase dikes, but further upward almost hidden beneath soil. Nearer to the head of the valley leading down to the Dshivei valley on this route a granite of the Baisút type is met with, reaching down to the main valley. Dikes of a red, aplitic granite set up through the main rock, but appear also as larger bosses. Both granites are crossed by numerous and mighty, partly coarsegrained diabase dikes.

Sp. 86, Foslie. Red granite. 5 versts before the farm Blinova, on the route from Sidzim.

At the confluence of the Uluk Dshivei and Pitchi Dshivei rivers a coarsegrained, weathering granite of the Baisút type outcrops. Besides there are some isolated areas of red aplite granite and some diabase dikes.

In the river gravel principally granite pebbles are found, both of the red and the yellowish-grey type, but also many eruptives of intermedial composition of changing aspect (syenite, labradorite), further some pebbles of finegrained diabase porphyrite, but none of quartz. In the mountain NW from the camp XVI a coarsegrained, yellowish-grey to white-grey hornblende granite was seen, apparently with but little of quartz megascopically visible. Dikes of red aplite granite and diabase cut through the former.

Then the Expedition followed upstream along the right side of Pitchi Dshivei (Little Dshivei). The bedrock consists here of (in order upstream) pale grey, coarsegrained granite at a distance of 5 versts, then of a finegrained, basic eruptive rock, disintegrated by jointing and carrying epidote veins. Further upward the coarsegrained grey granite appears again, repeatedly alternating with basic eruptives along a distance of ab. 5 versts. Then the bedrock consists exclusively of a very coarsegrained granite of red to yellowish red colours. This granite shows a striking similarity to the red granite type (the younger one), but on the other hand it has no definite limit against the grey (Baisút) granite.

The pebbles in the gravels along the river at camp XVII consist of granite (scarcely), abundantly of diabase porphyrite, felsite porphyry, basic abyssal rocks and of quartz.

When following the valley upstream from the mentioned locality (camp XVII), one observes a felsite porphyry and then a red granite, soon changing into a semi-porphyric red granite. A pegmatite dike of irregular habit carrying large masses of pure quartz, but without signs of any sulphides was seen. A diabase dike crossing the granite appears as well.

Sp. 87, Foslie. Pebble of diabase in the river gravels at camp XVII. Pitchi Dshivei.
» 88 » Diorite. 10 versts S from camp XVII. Ibid.
» 89 » Semi-porphyric granite. 4 $^1/_2$ versts S from camp XVII. Ibid.
» 90 » Finegrained porphyry, 2 $^1/_2$ versts S from camp XVII. Ibid.
» 91 » Finegrained basic eruptive rock with epidote veins. Granite terrane betw. the camps XVI and XVII. Pitchi Dshivei.
» 92 » Typical red granite at camp XVII. Ibid.

Further up the valley the rocks vary considerably. The commonest type is a grey, finegrained, biotite bearing granodiorite, locally of a dioritic habit, in parts pressed. Besides there are labradorite porphyrite and diabase. Then the uniform felsite porphyry again appears, being decomposed by weathering. The rock contains phenocrysts of feldspar in a quite finegrained groundmass of reddish colour. This rock is no doubt connected with the above characterized semi-porphyric granite.

Sp. 93, Foslie. Finegrained feldspar porphyry (large phenocrysts not visible in the specimen). 5 versts S from camp XVII. Pitchi Dshivei.

Following the valley of Pitchi Dshivei further upward the Expedition entered an extensive area of exclusively basic porphyrite rocks, in particular a diabase porphyrite, quite finegrained. The rock is apparently of effusive character. Then a relatively coarsegrained dioritic rock follows; in parts of massive, in parts of foliated habit. In the latter case the type changes into a hornblende schist. Besides there are masses of a finegrained, basic porphyry, alternating with the foregoing. The dioritic rock seems to be of abyssal habit. Further on an area of coarsegrained granite, partly associated with the diorite and reminding of the type at camp XVII, is met with.

The mentioned granite dominates further up the valley of Pitchi Dshivei up to the sources. From this valley head the Expedition crossed the divide and reached the upper part of Uluk Dshivei, this valley being here of considerable breadth, with steppe ground (fig. 41). The bedrock consists of coarse-grained diorite or hornblende gabbro, crossed by red granite. The last named rock dominates at the very border of the valley, to the W from the camp XVIII. Here the type is normal again as in the Sidzim valley.

Sp. 94, Foslie. Diabase porphyrite, 8 versts S from the camp XVII. Pitchi Dshivei.

Among the pebbles of the river gravels in this part of Uluk Dshivei was met with for the first time a typical white marble (orig. in Tangnu-Ūla). In the E side of the same valley, E from the camp XVIII, a hornblende-feldspar porphyry was seen. The rock is quite coarsegrained (part of a greater dike?). Then a side valley to Uluk Dshivei (right trib.) was followed upward toward the E. The rock here is a coarsegrained, red granite. The same type dominates also further eastward all the way to the Haptagai valley, showing everywhere the same habit, only with some variations in the size of the grain.

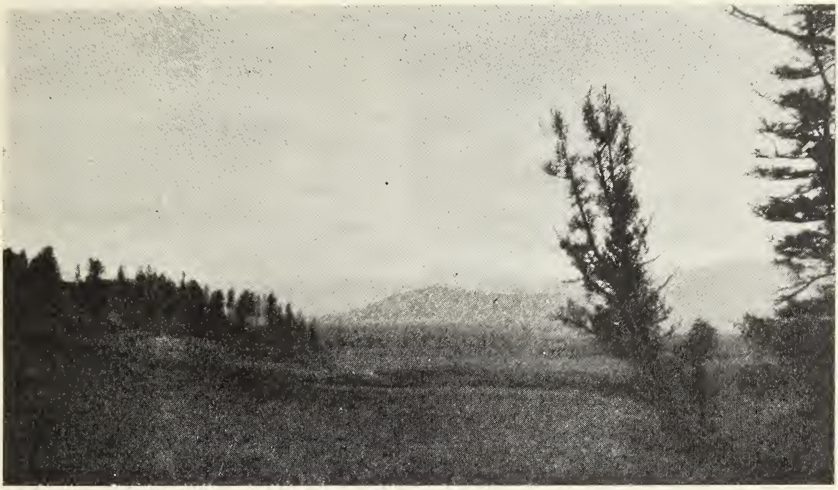

Fig. 41. The Uluk Dshivei valley, looking Eastward. Tangnu-Ūla in the background. Note the wide valley train.

Photo. St. Foslie.

Sp. 95, Foslie. Hornblende-feldspar porphyry. Pitchi Dshivei.
» 96 » Hornblende syenite (?). Pebble in the river. Upper part of the Uluk Dshivei valley.
» 97 » Granodiorite. 4 $^1/_2$ versts S from camp XVII, Pitchi Dshivei.
» 98 » Pebble of crystalline limestone. Upper course of the Uluk Dshivei valley.

When entering the upper course of the Haptagai valley one comes to an open steppe, but as it gets deeper, it is already a normal erosion valley. The mountain slopes on both sides consist of normal granite, and the summits often show the characteristic ruin shaped weathering forms, very common in granite terranes here.

The granite dominates in all parts for 5 or 6 versts before reaching the camp XIX. Here one enters an area of hornblende schist, of a streaky habit. Bands of dioritic and gabbroidal composition alternate. Dikes, irregularily oriented, of granite pegmatites set up through the rock, originating from the granite area.

Further down the valley the hornblende schist gets very schistose with strike N 20° E and dip 25° WNW. Still farther downward the schist has a flatter position. Just before reaching the camp XX one observes a curious pale coloured, porous rock (altered by weathering) probably originally a sulfide bearing rock.

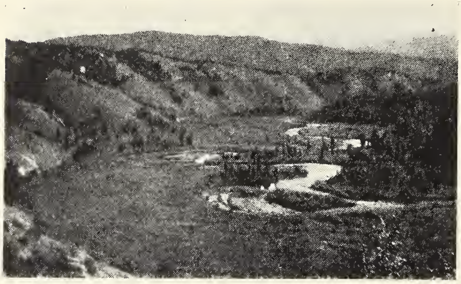

Fig. 42. The Haptagai river meandering in a mature valley

Photo. T. Hasselström.

N of the camp XX the hornblende schist strikes N 35° W—N 45° W. The dip is more or less steeply E.

The geological relations in the vicinity of the camp XX are, summarized, as follows:

Inside the very extensive area of red, coarse-grained granite, just crossed by the Expedition, there appears a large closed body of hornblende schist and diorite of greater age than the red granite. At the W border of the basic rocks there appears a number of dikes of granite pegmatite, apophyses from the granite. At the eastern border there are no pegmatite dikes, but a considerable mass of granite aplite apparently injected into the basic rocks and partly concordant with the schistosity. A last phase of the aplite injection was a silicification process and mineralization. Veins of quartz appeared in the aplite and in the hornblende schist, the latter being then transformed into chlorite schist.

Further down the Haptagai valley there is again the coarsegrained red granite, then hornblende schist rich in quartz veins and forming the continuation of the schist above mentioned.

Sp.	99	Foslie.	Altered basic eruptive rock. Haptagai valley.
»	100	»	Altered diabase with quartz veins. Ibidem.
»	101	»	Kaolinized rock. Ibidem.
»	102	»	Finegrained, aplitic granite. Ibidem.

When entering the Tarbagán valley one reaches a greater area of red granite. Further eastward crossing the watershed and reaching the Khargin gol valley one observes the same red granite crossed by some diabase dikes.

The boulders in the Khargin gol river bed consist of the following rock specimens: some coarsegrained red granite, abundantly middle grained grey granite and aplite. There are also numerous boulders of marble of different colours. Besides there are many eruptives of intermedial composition, some quartz pebbles and also quartzite (?).

Then the Khargin gol valley was followed on its right side upstream. Everywhere there is the red granite of a uniform habit. The rock is crossed by numerous dikes of diabase and porphyrite.

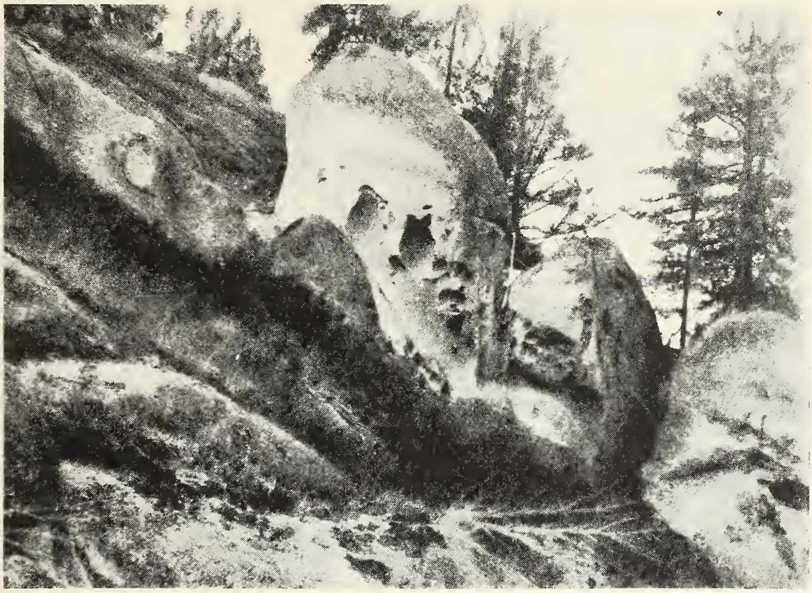

Fig. 43. Weathering forms in granite. Haptagai valley. Huakhem drainage.
Photo. Th. Brenner.

Further on at the same right side of the valley a mighty formation of coarse crystalline marble is met with, which soon is replaced again by red granite. The limestone formation extends in N:ly direction up along the mountain ridge, limiting the valley to the E. The marble is white and pure. It is crossed by narrow dikes both of the usual diabase and granite, the latter showing a typical pegmatitic character. Also dikes of feldspar porphyry were found.

The marble formation is here apparently an isolated mass lying in the granite. Contact minerals seem to be absent.

Sp. 107, Foslie. Quartzitic rock at the base of the limestone formation. Khargin gol valley.

Sp. 109, Foslie. Crystalline limestone. Ibidem.
» 110 » Porphyrite dike in the limestone. Ibidem.
» 111 » Finegrained basic rock. Ibidem.
» 112 » Porphyrite dike in the limestone. Ibidem.
» 113 » Gabbro (?). Camp XXIV. Ibidem.
» 114 » Mica gneiss cut by granite dike. Ibidem.
» 119 » Red granite-syenite betw. camps XXIV and XXV. Ibidem.
» 121 » Grey granite. N from camp XXIV. Ibidem.
» 122 » Coarsegrained red granite (typical) Betw. camp XXI and Brenners camp. Ibidem.

Further up the same valley there is again the red granite, in one locality enclosing a limestone mass ab. 50 m broad and running N 60° E.

Then the Expedition left the Khargin gol valley and went ESE. The coarsegrained red granite dominates to camp XXI and further toward the watershed ag. the basin of the Terinūr lake. Here and there are inclusions of an older hornblende schist.

From the watershed the red granite was observed to the Terinūr lake. This lake lies in a wide, shallow basin of steppe character.

In the direction SW from the lake there extends the broad valley Kuria. In this a fine lamellated chlorite schist (phyllite) was encountered, striking N 60° E and dipping steeply N. This schist contains numerous quartz lenses and shows in detail a kind of flowage.

Sp. 113, Foslie. Chloritic schist with quartz lenses. Vicinity of Kuria.
» 115 » Middlegrained dioritic rock, crossing the limestone. Camp XXV. Bokhúr valley.
» 116 » Amphibolite crossing the limestone. Ibidem.
» 117 » Basic schist with streaks of pyrite. Boulder in the Bokhúr river.
» 120 » Basic, iron-bearing variety of the gabbro, crossing the limestone. Bokhúr valley, below camp XXV.
» 123 » Limestone with wollastonite. Boulder in the Tarbagatai river.

From the Kuria valley the Expedition reached the Tashgún valley, separated from the former by a low ridge consisting of grey granite. In the river gravels of Tashgún there are pebbles of marble, in parts graphite bearing, further gabbro, hornblende schist, some finegrained grey granite and a few pebbles of quartz.

On the way from here to the Khargin gol valley (Tashgún is a tributary to it on the right side) eruptive rock of medium basicity was met with. Further up the Khargin gol valley a quite finegrained, gabbroidal rock dominates. Southward it is, however, soon replaced by a greyish-blue to white marble, running as it seems N 45° W.

When going further up the valley one meets with mica schists, in parts calciferous, highly crystalline and granite intruded. The strike is here N 50° W and the dip 55° SW. Southward from here the composition changes again: a red, coarsegrained typical red granite appears followed by more basic, red syenitic eruptives, soon replaced by finegrained gabbroidal types. Southward follows again a marble, forming lofty, rough crests on both sides. The last named rock dominates completely further in the same direction.

Then a little creek joining the main river from the right side, was entered (Khagol). In the gravel the pebbles consist principally of marble. The following creek, Bokhúr-rising SE:ward toward Tangnu-Ūla, shows everywhere a bedrock of marble, but often it is crossed by irregularly formed bodies of basic eruptives. At the contact between the marble and the eruptives one can observe in some places a concentration of magnetite. At camp XXIV the marble seems to be very coarsegrained and white and constantly graphite bearing. The basic eruptives crossing the marble can sometimes get quite coarsegrained changing into a pegmatitic mixture of hornblende and feldspar. The principal orientation of the injections seems to be ab. E—W. The origin of the graphite is evidently connected with these injections.

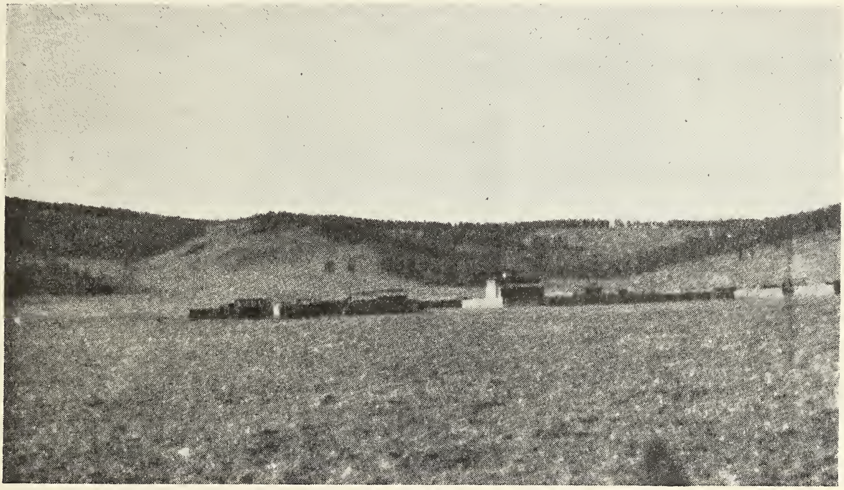

Fig. 44. Mature relief at Kuria, region of the Terinūr Lake. Old metamorphic rocks. Looking W
Photo. St. Foslie.

Further up along the same creek the marble outcrops continue, containing smaller intrusions of basic eruptives. The marble dominates up to a mountain crest, 2,130 m ab. the sea. This crest is a northern parallel chain to Tangnu-

Ūla, separated from the latter by the valley of Baligin-gol. The strike of the marble is here, as it seems N 40° E and the dip is steep.

In the main crest of Tangnu-Ūla there are jagged peaks (granite or marble?).

The Expedition returned the same way to Hlebnikova.

9) The Geological Outlines of the Huakhem Drainage Area from Hlebnikova in the west to the Terinūr (-kul) lake in the east. (Cfr. the itinerary Map n:o 3). By STEINAR FOSLIE.

The geological records of the area can be subdivided in the following scheme:

1. Alluvial deposits in the river beds including the terrace gravels. In the valley of Huakhem there appears on higher levels remnants of basaltic lava flows, once filling the valley to certain heights.

Unconformity.

2. The Devonian sandstone area at Hlebnikova, consisting of a series of several hundred meters of thickness of sandstones, arcoses, conglomerates and limestone and also a single lava intercalation of basalt. The area is partly limited by faults.

Unconformity.

3. Dikes of diabase and labradorite porphyrite.

Eruptive contact.

4. Red quartzporphyry, downward gradually changing, as it seems, into
5. red (younger) granite.

Eruptive contact.

6. Yellowish-grey and grey (older) granite of the »Baisút type» and probably of other types too.

7. Quartz diorite and diorite, probably also gabbro, representing basic differentiations from the foregoing magma.

Eruptive contact

8. Dioritic and gabbroidal types (older) of abyssal habit and corresponding to surface-rock types, chiefly diabase porphyrites. Also hornblende schists.

Eruptive contact.

9. Crystalline schists, mainly mica schists and limestone-marble, partially quartzite and injection gneisses, formed during the intrusion of the older granitic magma.

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The alluvial deposits of gravels and sands form generally the valley trains. These appear in all the tributary valleys of the Huakhem system visited by the author. Except the main river valley there are no high level terraces of a greater age to be seen. The valley train is almost a plain surface, well limited by the steep valley walls and of considerable breadth. In the lower part of the Dshivei valley the breadth of this train can attain nearly 3 versts.

Many times the underground water appears on the surface of these trains, producing a swampy floor. The riding paths must thus climb the rough wall slopes. Further up the valleys the conditions change, so that the walls rise more gradually from the valley floor, and the underground water disappears from the surface. Dry ground of steppe character is here common.

The Huakhem valley offers a somewhat different aspect. We have here apparently a quite recent down-cutting of the river bed as a consequence of an upheaval of the land surface. The main valley is rejuvenated to a higher degree than the side valleys, and terrace remnants are, as said, quite common along the valley walls. The river has likewise cut down through the youngest alluvials of the ground and reached the bedrock. This valley is thus better drained than the side valleys and where terraces occur, they are dry and better for traffic.

The geological relations of the Huakhem valley and the basalt lava flows of it have been studied more in detail by BACKLUND.

An interesting fact to be mentioned here is, that nearer to Tangnu-Ūla and to the south from the Terinūr lake, quite similar conditions to those existing in the Huakhem valley occur. The Khargin gol river shows in its upper course a recent rejuvenation of the erosion. There are mighty side terraces consisting of coarse gravels, and the river has cut down through the youngest train and reached the bedrock. The valley is thus dry and can easily be used for traffic.

The small area of Devonian sediments at Hlebnikova has been described by the author in a separate communication (see page 132!) and may therefore not be characterized here. This occurrence is the easternmost and southernmost found inside the Uriankhai country, because neither the author nor the geologists of the other parties have been able to show any remnants of the mentioned formation in regions lying more eastward.[1] On the other hand, however, it may be stated, that the important fault lines, limiting the Devonian area, also continue into the older terranes, where they may play a considerable rôle in tectonical sense, although it may be a difficult task to localize them there without more detailed studies.

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[1] At Ust Ushep there was found, however, a pebble of psefite of Devonian habit and likewise a pebble ot middle Devonian limestone with fossils at Ust Kongi (BACKLUND).

Rocks of a geological age antedating that of the Devonian formation belong to a series of basic eruptive dikes of diabasic and porphyritic kinds. They have been observed in a very extensive area, and their occurrences are numerous. They set up through the »younger red granite» and also the aplitic, subsequent differentiations of the latter magma. On the other hand the dikes are still more numerous in the older granite terrane of the »Baisút type» and also in the basic differentiations and inclusions occurring there. In the greater areas of basic rocks the mentioned dikes can hardly be observed. The author has not seen them in the youngest quartzporphyry, but his fellow geologists report such occurrences from adjacent areas. This fact seems very probable, because the quartzporphyry and the red granite in question are doubtless intimately connected one with another.

In this way, the extension of occurrences of basic dikes broadly will cover the area studied by the author, except the southern part lying on the Tangnu-Ūla side, where crystalline schists and limestones dominate, and where such dikes seem to be absent. To the north from Yenissei, in the region of Ushep and the Idyk Mountain, they decrease in number. It may therefore appear as if the occurrences of basic dikes have a close connection with the areas of the »younger red granite» and regions lying near to it.

The dikes are in every place perfectly limited and often straight lined. They seem to be directed principally from the north to the south, with smaller deviations. There are, however, various exceptions in this respect, and some of the dikes have a quite irregular course. The thickness is often 1—3 m, but the author has also noted up to 20 m of the same dimension, as well as down to a few cm. In the last case there are generally »swarms» of dikes, sending apophyses into the side rock.

In the Devonian area these dikes are not observed, in spite of the fact that they hardly could escape the eye. If it will be proved, that the dykes really are absent in this terrane, there is no possibility to bring them into connection with the basaltic sheets intercalated in the Devonian series, although one at first may be inclined to such an idea. It seems therefore probable, that these dikes are nothing but the last differentiation product of the younger, red granite magma. The dike intrusion occurred, however, after the cooling of the magma. They cut sharply across the last aplitic differentiations of the granite, already distinctly separated from the latter. In some of the greater dikes of diabase, s. a. at the farm BLINOVA in the Dshivei valley, there appears a marked fringe of fine grained diabase against the walls, while the main rock is very coarsegrained. This finegrained fringe is due to a more rapid cooling against the surrounding red granite.

The red quartzporphyry appears in an extensive area at Hlebnikova and likewise up the Bilbei valley, where it forms exclusively the basement of the Devonian formation. (At Hen Bren the Devonian rests immediately on older rocks, according to BRENNER). The quartzporphyry appears in some different types, generally of a red colour with principally quartz phenocrysts, but there is also a grey type with only feldspar phenocrysts. In the quartz-porphyry there are in many places considerable masses of well stratified tuff layers, possibly also agglomerates, as 10 versts to the north of Hlebnikova and to the east of the lower part of the Bilbei valley. When quartzporphyry is reported from the midst of the red granite area, it seems most probable that the occurrences may represent dikes in the latter.

The quartzporphyry observed by the author from the middle course of the Little Dshivei valley is generally finegrained and felsitic. It belongs probably to the older group of porphyries.

The younger red granite is the commonest country rock in the area studied by the author. According to the itinerary map n:o 3 it seems that this rock appears chiefly in a broad zone along the northern foreland of the Tangnu-Ūla mountain chain and moreover at the base of the quartzporphyry formation in an extensive area at the lower course of the Sidzim and Dshivei rivers. In the latter region there are semi-porphyric intermedial stages of rock types, indicating a possible transition between the deepseated granite and the quartzporphyry and also an intimate connection between them.

The red granite, typically developed can easily be kept aside from the older granites. There are, however, some localities, where one may stay doubtful. The habit of the red granite is always that of a uniform and unpressed structure, not altered and generally coarsegrained. It shows no differentiations into more basic members, but seems to carry in many parts inclusions of older such rocks, resorbed to a higher or smaller degree. At the contact line of the red granite against the older Baisút granite there appears as a rule a finegrained zone and likewise dikes and smaller areas of a throughout finegrained red granite aplite (for inst. at the camp VII). These red aplitic dikes are found also to a smaller degree in the midst of the red granite with the character of last intrusion products. It is not always demonstrated that these red aplites could not also be differentiation products from the older granites, with which they are generally closely connected. The fact, however, that the aplitic dikes are principally distributed along the contact lines of the red granite areas, seems to demonstrate that the dikes stand in magmatic relation to the latter ones.

The mentioned finegrained boundary facies points to a marked hiatus between the two granites. There is no evidence of a sediment formation from this interval in the geologic records.

The older granites are of much more changing aspect. One can find a great number of types, and it may be doubtful if all the varieties belong to the same eruption. There is, however, not sufficient material for a more detailed division.

One of the common est types of the granites in question is the so called »Baisút granite», which first was found in the Leonoff goldfields, lying in the Baisút valley at some distance from Bielotzarsk to the east. This granite is typically developed, yellowish-grey, coarsegrained, not crushed and with hornblende dominating among the dark minerals. The rock contains often basic differentiation products of a quartzdioritic and dioritic character. There are also inclusions of older basic eruptives, partly resorbed. It was an impossible task to separate all these basic members on the geological map.

In places where the granite in question comes into contact with crystalline schists, the latter have been injected, being transformed into injection gneisses and partly into migmatites (for inst. in the Sidzim valley). In the mentioned case the granite is often finegrained and of an even grey colour and abundantly accompanied by quartz veins. In some areas the granite seems to be markedly pressed (for inst. to the east of the camp VI).

The older granite is of a different aspect on the Idyk Mountain, to the north of the Huakhem valley. It is here a pale greyish, coarse grained biotite granite, which also forms injection gneisses with the near lying older schists.

In a few localities one finds granites, whose relation to the mentioned main groups (red and grey granites) is quite doubtful. To these belong e. g. a grey, middlegrained granite in the northern slope of the Tangnu-Ūla mountains in the vicinity of the camp XXIII. On the map it has been classified together with the older granites (the grey ones).

The older basic eruptives are partly typical hornblende schists, of which greater or smaller fragments are enclosed in the older or younger granites, as for inst. in the vicinity of the camp XX, partly massive gabbroidal or dioritic, deepseated rocks and with these connected effusive rocks, s. a. labradorite porphyrite (Little Dshivei) and dark grey, quartz and feldspar bearing porphyry (Sidzim). The basic rock at the camp XXIII seems to differ petrographically from the others.

The oldest sedimentary formation in the surveyed area is a mighty and extensive series of crystalline schists of unknown age. It appears partly as isolated areas surrounded by granite s. a. in the upper course of the Sidzim valley and up towards the Little Dshivei valley. Here a mighty complex of steeply inclined mica schists is met with, enclosing isolated layers of quartzite. The complex is intruded by hornblende schist and likewise by granite pegmatite with numerous quartz veins. Further northward, along the Sidzim river, there appears an extensive area of typical sedimentary gneisses, differing from the above described by a more intense injection of granitic material. A similar sedimentary area is to be found on the east side of the Idyk Mountain to the north of the Huakhem valley, being an outlier of a great area of old crystalline schists, described by prof. BACKLUND, from the neighbouring districts.

The principal area of the described formation to the south from the Huakhem valley is met with in Khan Taigá, to the north of the main crest of Tangnu-Ūla and to the south of the Terinūr lake, thus in the southeasternmost corner of the area surveyed by the Expedition.

In this region one meets with immense masses of white crystalline limestone, composed of coarsegrained calcite, and containing relatively scarce interstratifications of mica schists. These rocks are to a great extent intermingled with basic eruptives, and in one place also intruded by a more limited massive of red granite, coarse-grained, showing transitions to a red, nearly quartz-free syenite.

This formation is strongly folded and strike and dips are very slightly developed in the massive marble. In the southern part of the area the principal trend seems to be, however, parallel with the mountain axis of Tangnu-Ūla.

It may be supposed with reason, that this mighty formation continues for a long distance towards the east as well as towards the west. Eastward the country is still unexplored in geological sense. In the westerly direction the marble formation extends, as may be supposed, at least to the sources of the Great Dshivei river. The author found in the named river valley and in the Tarbagatai valley numerous boulders of marble in the gravels of the upper parts of their courses. The remarkable great inclusions of white marble in the red granite area at the middle course of the Khargin-gol river are without doubt some loosened parts of this formation.

As far westward as in the Bren valley BRENNER has observed inclusions of this limestone formation in the granite, but it has not reached further westward from the Shurmak Pass, where the areas of the Tangnu-Ūla mountains explored by BACKLUND and HAUSEN are met with.

Christiania, March 1922.

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[1] As has been shown in the itinerary descriptions, crystalline limestones are quite common in the part of Tangnu-Ūla lying to the west of Shurmak.
The Editor.

10) Geological Data from adjacent Regions in the east, compiled by H. HAUSEN (see the Bibliography II).

Khan Taigá and Ulán-Taigá.

The travels of POTANIN 1877 and 1879[1] have brought some geological informations from these regions. During his first journey (1877) POTANIN crossed the country from the S end of Kossogól westward across the valley of Delger muren and then down the Tess river to Ubsa-nūr. In the vicinity of the outflow of Egingól from Kossogól POTANIN observed crystalline limestone with strike NW—SE occurring also further westward together with gneiss. Along the valley of Naryn, leading down to Delger-muren, there is a grey crystalline limestone, crossed by dikes of porphyry. The valley of Delger-muren is at the confluence with Naryn also eroded in limestone. In the river bed of the former great boulders of granite were observed. In the pass Batyren-Dabán limestone again appears, clearly stratified. The strike is here N 30° E and the dip NW 51°. Further westward granite gets the more dominant member. The pass Ire-Khaldsyn-Dabán consists of red granite. In the Shiabir valley leading down to Tess (to the W) there is chiefly granite, but here and there also limestone, running NW—SE. Further westward there is still granite with masses of limestone reaching down to Dzindzilik.

During his second journey (1879) POTANIN came from Terinūr, crossing the ridge of Khan-Taigá, then the valley of Delger-muren and reached Kossogól. The geological data communicated are scarce. In the slopes og Khan Taigá toward the Terinūr basin POTANIN saw grey granite and higher up in the Agash valley crystalline limestone. At the sources of the same valley a slaty limestone occurs. On the other side of the watershed, in the valley of Tshinty there is still the same rock. Down the Agar valley grey granite is met with intruded in a mighty limestone formation, running in one locality N 10° E. At the mouth of Agar the Delger-muren river runs between high cliffs of limestone.

The Kossogól Rayon (with Munku Sardyk).

The geographical-geological literature concerning this part of northern Mongolia is not so scarce as could be imaginated, but is, however, not sufficient for a synopsis. The principal studies to be mentioned are those of DE HENNING MICHELIS (1898) and PERETOLTCHIN (1903). In more recent times TOLSTICHIN (1920) has made some observations along the eastern shore of Kossogól and further southward. By transporting all the data available on to the map of Kossogól and surroundings made by DOROGOSTAYSKY (1909) one gets, in all cases, an orientation regarding the geological structure of the region. Some observations of the author along the road Mondy—Hangá—Turúk may be of interest in this connection.

The imposing mountain range to the north from the lake basin of Kossogól, the Munku Sardyk (culminating point 3,825 m) is principally composed of biotite granite and gneiss, in the northern slopes, however, of crystalline limestone to a great extent largely exposed at the canyon of Biely Irkut. The ridges to the E of Munku Sardyk (Polosatya Gory) being considerably lower, show crystalline limestone too, but here interstratified with chlorite and amphibolite schists. The strike of the schists is N—N 30° W. The table mountain named Yangit on the S slope of Munku Sardyk seems to consist exclusively of basalt, because the sides are full of basaltic boulders. When approaching to the shore of Kossogól, one meets with chlorite and amphibolite schists.

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[1] Г. Н. Потанинъ: Очерки Сѣверозападной Монголіи. Вып. I и III. С. Петербургъ 1881—1883.

In the watershed between the Mondy valley and the basin of Kossogól (the Siberian--Mongolian boundary) there are hillocks consisting of hornblende and chlorite schists running N 40° W with a steep dip.

Examinating the pebbles in the little river bed of Hangá, coming down from the Munku Sardyk massive, the author found principally granite, amphibolite, metamorphic schists and crystalline limestone and also frequently a porous basaltic lava of black-violet colour, apparently originating in the Yangit mountain. At the mouth of the little river Norin Habsyl limestone appears, running N 8° E (PERETOLTCHIN). The rocky cape at Hangá in the lake consists of lava.

When following the shore of the lake towards the E and SE one meets with lower rocky grounds, but with steeper shore cliffs, extending nearly along the whole E shore. The shore line itself forms numerous shallow bays and promontories. Between Hangá and Turúk the principal rocks are greenstone and granite, the latter red or grey. A mountain ridge to the E from the farm SPIEGEL at Turúk, consists of red granite. The pebbles in the river bed at Túruk, descending from the mountain plateau in the E, consist to a considerable degree of basaltic lava. The frequency of these pebbles increases eastward, indicating that the flat mountains to the E probably consist of lava.

At the mouth of the little creek Shognul one meets with basaltic lava covering a ground of granites and gneisses. At Noungól the lava again dominates. Southward from the cape Sypsul there is biotite gneiss running E 75°—87° S and dipping 50°—90° SW. Further southward, to the S from Angihotai one observes granitic and gneissic rocks, the latter striking N 60° E.

The little Island Dalai-kui in the S part of the lake consists of hornblende-biotite granite and syenite.

The cape Dolbaish still further southward is composed of basaltic lava, lying as a mighty cover over a biotite gneiss, the strike of which is N 85° E and the dip 80° NW.

The broad valley of Borsok lies partly in lava ground, partly in gneiss. In the Moto bay further southward there is lava and gneiss too, the latter enclosing layers of quartzite and crystalline limestone. The strike of these schist rocks is N 18° W, the dip 63° SW. Opposite the little island Elisin Hupsul there are again rocks of lava resting over a basement of biotite gneiss the latter with strike N 77° E and dip SE 59°. Still further southward the lava gets more scarce and the basement rocks come to show, principally gneiss here and there penetrated by granite. Southward from the mouth of Keksyr a biotite gneiss is met with with strike S 54° E and dip 55° SW.

On the very shore to the W from the creek of Alaksyr there is actinolite schist with quartz veins. The strike is here N 74° E and the dip 75° SE. In the southernmost bay one meets with limestone and silica schist.

At Tshulushai there is red granite coarse grained. Then there follows again silica schist striking S 66° E and dipping 80° SW.

Opposite the island Baga-kui one observes, in the W shore of the S prolongation of the lake (head of the outflow Egingól) limestone. To the N from here follows clayish slate, then red gneiss and quartzite. Further N:ward there is only lava. At the mouth of Hara-usú the last named rock rests on a basement of limestone and phyllite. Still further N:ward granite and gneiss dominate.

To the N from Dsheglyk talc schist appears, carrying interstratifications of quartzite. The strike is here N 60°—73° E and the dip 60°—70° SE.

At the mouth of the creek Uley there is red granite. In the direction of Hoton the red granite still dominates.

The peninsula Dolon-Ūla (NW shore of Kossogól) shows along the shore (starting from the mouth of Hoton and going N:ward): actinolite schist with strike N 36° W and dip 65° SW, further amphibolite gneiss strongly pressed and running N 70° W dipping 62° SW. Besides there is phyllite with strike N 40° W and dip 65° SW. In the E shore of the peninsula there are rocks of red granite and limestone. Further northward gneiss and actinolite schist are met with [1].

The mountain Bain-Ūla lying at the northernmost end of the lake consists of diorite, hornblende gneissgranite and eyegneiss (De Henning Michelis).

In the report of Potanin from these regions, crossed by him in the year 1880, there are very scarce geological data: along the Gorchon-gól and in the valley of Shishkit are »cliffs of lava». The mountains rising to the E from Gorchon-gól consist of limestone being partly schistose and shows then transition to black clayish slate. These rocks strike N 41° W. The lake Dod nūr is on all sides surrounded by lavas, wich probably have no greater extension.

The Tunka Valley Region with Tunkinskie Bielki and Kitoiskie Goltzy.

As a natural continuation to the W of the great downthrow Baikál the tectonical valley of Tunká or Irkut can be considered, separating the East Sayans from the Mongolian Highland Plateau (»Vyssokoie Ploskogorie» of P. Krapotkin). The southern border of the East Sayans in these regions is named Tunkinskie Bielki (Bielki —»White mountains») a jagged snowclad range of considerable heights. To the north of this crest there is another called Kitoiskie Goltzy, both rising over an upland surface or highland plateau, which in general dominates nearly the whole East Sayans in the Irkutsk Government.

Already by the reconnaissances of Meglitzky (1855) the main geological features of the Tunká valley region were obtained, but afterward new contributions were brought by Tshersky (1873), Yatcheffsky (1888), Obrutcheff (1890), another time Yatcheffsky (1899), and Lvoff (1910). In the last years before the Revolution the Russian Geological Committee started a systematic survey of the region in relation to a topographical mapping of the same, but the reports hitherto issued are very short (PREOBRASHENSKY 1915). It may be convenient to summarize the data obtained from these geologists. As a whole they are very sporadical in comparation with the extensive areas under consideration and are far from sufficient to give an idea of the main geological features. Some observations made by the author may be added to this picture.

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[1] All these data are communicated in the report of Peretoltchin. The rock specimens collected by him (102) were examined by prof. Stuckenberg in Kazán.

If we follow the Irkut (Tunká) valley downward from Munku Sardyk, we note at first the great development of crystalline limestone in the Munku Sardyk and its surroundings (profile in the lower part of the Irkut canyon). To the S of Mondy MEGLITZKY (1855) noted a dark green finegrained clayish slate (?) standing conformably with limestone complex. In the latter there are also according to him frequent alternations between limestone, mica-chlorite schist and gneiss, a structure crossed by the Irkut canyon. In the immediate vicinity of Mondy there is a granite outcrop.

On the N side of the main valley downward from Mondy there are principally fine grained crystalline limestones, in parts also coarsegrained alternating with gneiss, mica- and chlorite schist. Bodies of granite cut through the structure.

The low ridge between the Irkut river and the Hoitogól valley consists of greenstones, and dark phyllites (?) cut across by granite-syenite.

In this connection it may be convenient to add some of the author's own observations referring to the route Turán—Ihe Ugun—Ule Dabán—Kitoi—Nogon Ūla region—Irkut—Mondy. This ride was undertaken in the winter 1919. The collections made were all lost in consequence of political difficulties and likewise the geological annotations, but some scattered data have, however, been preserved.

After crossing the river bed of Irkut below Turán one approaches a lower ridge, separating the Hoitogól valley from Irkut. The outcrops are at first at the path partly crystalline limestone, but further on in the ridge fine grained diabase, crosscutting the limestone.

The boulders in the alluvial cones descending from the alps opposite Hoitogól show principally granites, amphibolite and crystalline limestone. The lower slopes seem to consist of granite.

On the way up the valley Ubur Hongoldoi, a narrow gorge in the mountains leading up to the pass Ule Dabán, there is only granite-syenite to be seen. The pass named lies in a garnet bearing gneiss, northward showing transition into a mica gneiss, composing the mountains at the sources of Ara Hongoldoi, a little tributary to the upper Kitoi river. The valley of Ara Hongoldoi is broad and U: shaped, a typical glaciated valley. In the pass Ule Daban there are »roches moutonnées» with striae directed southward.

When following the Ara Hongoldoi valley to the N, one observes that the gneiss terrane suddenly is replaced by a series of sedimentary rocks lying with a marked unconformity on the gneiss. The lowermost member of the younger formation, dipping northward, is a coarse conglomerate with boulders of the underlying gneissic rocks and a cement of dark quartzite. The following member in the series is a dark quartzite-psammite, which further northward is concordantly replaced by a limestone formation of unknown thickness. All the mountains in the vicinity of the place, where Ara Hongoldoi joins the Kitoi river, consist of this limestone, which seems to extend also further down the Kitoi valley (E:ward). When following the Kitoi river upstream, to the N, one meets with numerous interstratifications of chlorite schists in the limestone.

The mountain ridge Nogon-Ūla at the sources of Kitoi is a serpentine massive of considerable length lying as it seems conformably in the limestone — chlorite schist — formation. The serpentine carries a network of serpentine — asbesto veins (The Ilshir asbesto mines). The Nogon-Ūla massive continues up the Samarta valley (head arm of Kitoi) to the ENE with limestone and schists on both sides. Somewhat more northward there is another zone of serpentine, as it seems parallel to the former and composing a. o. the mountain Ulan Hardyk (=»the Red Mountain», so called because the serpentine gets a reddish colour in weathered surface). The high mountains at the head of the Samarta valley consist of the limestone formation, capped with horizontal basic lava sheets, remnants of a former great effusive formation (cfr Ed. Suess: Das Antlitz der Erde, III Teil. page 53 a. f.).

Nearly all the mountains in the region of Nogon Ūla-have rounded glacial shaped contours and the valleys are broadly U:shaped with moraine loaded bottoms. Erratic boulders of glacial origin are scattered up to the plateau-like summits. Only the serpentine and basalt crests at the upper Samarta show jagged forms. They have no doubt once formed monadnocks rising over the inland ice, which in the Quaternary period covered the whole upland surface of the East Sayans.

The mountain ridges surrounding the basin of Ilshir-nūr, the head lake of the Irkut river, consist partly of crystalline limestone, partly of greenstones. This lake lies in a landscape of glacial relief, but the outlet valley Irkut descends rapidly into a canyon, which leads down to the Mondy valley. In the upper part of the canyon the limestone and greenstone still dominate, but below the tributary Temersuk there are mica- and quartzite schist and also limestone, all penetrated by granite. Any unconformity as in Ara Hongoldoi could not be detected. When approaching the mouth of Biely Irkut, the limestone gets mightier. It seems to dominate not only in a greater part of Munku Sardyk, but also in the mountains rising to the N of the Mondy valley.

The mountain slopes to the S of Turán consist of basaltic lava in the fore hills, but farther upward granite of greyish colour dominates.

The northern wall of the Tunka valley has been surveyed by Tshersky (1873) from Hairem eastward. The boulders in the alluvial fan of the named valley consist of limestone, partly skarn, partly schistose and showing transition into mica schist, further chlorite gneiss and augite diabase. In the valley there are outcrops of limestone.

At the termal waters of Arshan, to the N from the village Tunká appearing at the edge of the valley wall (foot of the Bielki) there is a slaty, fine crystalline grey limestone, striking WNW and dipping S:ward. When going up the gorge, one meets with chlorite schist. Then there is (upward) granite, being in higher levels replaced by limestone and chlorite schist all running NW and dipping SW.

VI. Bibliography I.

(Concerning principally the Territory of Uriankhai and the West Sayan Mountains).

1751 — D. E. GMELIN: Reise durch Sibirien von 1733—43. Göttingen.

1801 — P. S. PALLAS: Reise durch verschiedene Provinzen des Russischen Reiches 1771—1776. *2:te* Auflage. Band III. S:t Petersburg.

1838 — A. ERMANN: Reise um die Erde. Band II. (With a geological map of the northern part of the Asian Continent). Berlin.

1845 — P. de TCHIHATCHEFF: Voyage scientifique dans l'Altai oriental et les parties adjacentes de la frontière de Chine. Paris.

1860 — И. ПОЛЕТИКА: Геогностическое описаніе частныхъ золотыхъ промысловъ Маріинскаго округа, Томской губ., Ачинскаго и Минусинскаго округовъ, Енисейской губ. Вѣстникъ Имп. Русскаго Географическаго Общества. Часть 28, II. С.- Петербургъ.

1864 — Л. ШВАРЦЪ: Подробный отчетъ о результатахъ излѣдованій Математическаго отдѣла СИБИРСКОЙ ЭКСПЕДИЦИИ, Имп. Русск. Географ. Общества. — Путешествіе прапорщика КРЫЖИНА въ 1858 г. — Путешествіе Начальника Экспедицій въ 1858 г. — Указатель собранныхъ Начальникомъ Экспедиціи образцовъ горныхъ породъ во время путешествія по Минусинскому округу, Енисейской губ. въ 1858 г. Приложеніе 1: Геогностическая часть путешествія Л. ШВАРЦА по Минусинскому округу, Вост. Сибири. Составлена проф. К. ГРЕВИНГКОМЪ. (Съ петрографической картой). С.- Петербургъ.

1875 — П. КРОПОТКИНЪ: Орографическій очеркъ Минусинскаго и Красноярскаго округовъ, Енисейской губ. (Съ картой). Зап. Имп. Русскаго Географическаго Общества по общей географій. Томъ V. (Съ орографической картой). С.- Петербургъ.

1881 — К. ШАРНГОРСТЪ: Результаты барометрическихъ определеній высотъ Г. Н. ПОТАНИНА въ Монголіи. Извѣстія

ИМП. Русск. Географическаго Общества. С.- Петербургъ.

1883 — Г. Н. ПОТАНИНЪ: Очерки сѣверо-западной Монголіи. Выпускъ III. Дневникъ путешествія и матеріалы для физической географіи и топографіи сѣверо-зап. Монголіи. С.- Петербургъ.

1883 — ТОПОГРАФИЧЕСКОЕ ОПИСАНІЕ пути, пройденнаго по сѣверо-зап. Монголіи въ 1879 г. штабскапитаномъ Корпуса Военныхъ топографовъ ОРЛОВЫМЪ. Приложеніе къ ст. ПОТАНИНА (1883). С.- Петербургъ.

1883 — J. SCHMALHAUSEN: Pflanzenpaläontologische Beiträge II. Pflanzenreste aus der nordwestlichen Mongolei. Bulletin de l'Academie IMPÉRIALE des Sciences de S:t Pétersbourg. Tome XXVIII. S:t Petersburg.

1886 — А. В. АДРІАНОВЪ: Путешествіе на Алтай и за Саяны, совершенное въ 1881 г. Записки Имп. Русскаго Географическаго Общества по общей географіи. Томъ XI. С.- Петербургъ.
Съ Приложеніемъ профессора ШМАЛЬГАУЗЕНА.

1889 — Экспедиція Н. О. КАТАНОВА въ сѣверо-западную Монголію и Урянхайскую землю. Отчетъ за 1889 г. И. Р. Г. Общ. С.- Петербургъ.

1890 — А. М. АФРИКАНОВЪ: Урянхайская земля и его обитатели. Извѣстія Вост. Сиб. Отд. И. Р. Г. Общ. Томъ XXI. № 5. Иркутскъ.

1891 — Д. КЛЕМЕНЦЪ: Краткій предварительный отчетъ объ экскурсіяхъ въ системѣ Абакана, etc. . Зап. Зап. Сиб. Отдѣла И. Р. Г. О. кн. XI. Омскъ.

1891 — » » Матеріалы, собр. при эксп. на верхнем Абаканѣ въ 1883—84 г. Зап. Зап. Сиб. Отд. И. Р. Г. О. Томъ XI.

1893 — Путешествіе П. Н. КРЫЛОВА въ Урянхайскую землю въ 1892 г. (Съ картой). Изв. И. Р. Г. О. Томъ XXIX. Вып. IV. С.- Петербургъ.

1893 — А. Л. ТИЛЛО: Абсолютныя высоты, опред. П. Н. КРЫЛОВЫМЪ въ 1892 г. въ Урянхайской семлѣ. Изв. И. Р. Г. О. Томъ XXIX. Вып. IV. С.- Петербургъ. (Reprinted 1903. See КРЫЛОВЪ 1903).

1893 — К. БОГДАНОВИЧЪ: Предварительный отчётъ о геологическихъ изслѣхованіяхъ, ироизведенныхъ въ Сибири въ 1892 г. К. БОГДАНОВИЧЕМЪ и П. ЯВОРОВСКИМЪ. Горный Журналъ № 9. II. С.- Петербургъ.

1894 — К. БОГДАНОВИЧЪ: Желѣзорудныя мѣсторожденія Енисейской губ. и Абаканскій желѣзодѣлательный заводъ. Горный Журналъ. № 10. С.- Петербургъ.

1895 — В. С. РЕУТОВСКІЙ: Полезныя изкопаемыя Сибири. Казенное изданіе. С.- Петербургъ.

1895 — СЕМЕНОВЪ и ПОТАНИНЪ: Алтайско-Саянскя горная система. Дополненіе къ III тому Землевѣденія Азіи, КАРЛА РИТТЕРА. С.- Петербургъ.

1896 — A. SAYTZEFF: Matériaux pétrographiques recueillis par M. M. KRYLOW et KLEMENTZ dans les monts Saïans et dans la région d'Ourankhaïsk. Изв. Томскаго Университета. Томъ. IX. № 6. Томскъ.

1896 — В. С. РЕУТОВСКІЙ: Золотоносный районъ средняго теченія р. Большого Абакана. Съ геолог. картой въ масштабѣ 5 в. въ 1 англ. дюймѣ. Томскъ.

1898 — П. Е. ОСТРОВСКІЙ: Краткій отчетъ о поѣздкѣ въ Тоджинскій хошунъ, Урянхайской земли. Изв. И. Р. Г. О. Томъ XXXIV. С.- Петербургъ.

1899 — D. KLEMENTZ: Voyages en Mongolie Occidentale de 1885 à 1897. Bull. Soc. Géogr. 7 sér. Tome XX. Paris.

1910 — ED. SUESS: Das Antlitz des Erde. Dritter Band. Erste Hälfte. Dritter Abschnitt: »Der Alte Scheitel» (pag. 53). Wien.

1903 — Р. Я. КОНЬ: Предварительный отчетъ объ экспедиціи въ Урянхайскую землю. Изв. Вост. Сиб. Отд. И. Р. Г. О. Томъ XXXIV. № 1. Иркутскъ.

1903 — П. Н. КРЫЛОВЪ: Путевыя замѣтки объ Урянхайской землѣ. Зап. И. Р. Г. О. по общ. географій. Томъ XXXIV. № 2. С.- Петербургъ.

1903 — А. ЗАЙЦЕВЪ: Петрографическій матеріалъ, собранный П. Н. КРЫЛОВЫМЪ въ 1892 г. на Саянахъ и въ Урянхайской землѣ. Приложеніе 1. къ статьѣ КРЫЛОВА: Путевыя замѣтки объ Урянхайской землѣ. Зап. И. Р. Г. О. по общей географій. Томъ XXXIV. № 2. С.- Петербургъ.

1906 — В. А. ОШУРКОВЪ: Отчетъ о поѣздкѣ, совершенной лѣтомъ 1902 г. въ зап. Саяны и зап. часть хребта Танну Ола. Зап. Красноярск. Подотд. Вост. Сиб. Отд. И. Р. Г. О. Томъ I. Вып. I. С.- Петербургъ.

1906 — RUSSIAN GEOLOGICAL COMMITTEE: Explanatory Text to the geological Map of the Part of Siberia investigated by Order of the Siberian Railway Committee. S:t. Petersburg.

1908 — А. БУЛГАКОВЪ: Верховья р. Енисея въ Урянхаѣ и Саянскихъ горахъ. Изв. И. Р. Г. О. Томъ XLIV. С.- Петербургъ.

1908 — А. В. ВОЗНЕСЕНСКІЙ: Землетрясеніе на Танну Ола въ 1905 г. Извѣстія Вост. Сибирскаго Отд. И. Р. Г. О. Томъ XXXV. Иркутскъ.

1907—09 — J. G. GRANÖ: Matkamuistelmia Länsi-Siperiasta ja Mongoliasta. Meddelanden av Geografiska Föreningen i Finland. Bd VIII. N:o 3. Helsingfors.

1909 — К. ДОЛБЕЖЕВЪ: Дархатскій округъ. Труды Троицкосавско-Кяхтинскаго Подотд. Пріамурскаго Отдѣла И. Р. Г. О. Томъ XII.

1909 — A. PAQUET: Südsibirien und die Nordwestmongolei. Jena.

1909 — Л. ЯЧЕВСКІЙ: Геологическія наблюденія въ районѣ золотыхъ промысловъ по р. Б. Кызасу. Геол. Изслѣд. въ золотоносныхъ областяхъ Сибири. Енисейскій золотон. районъ. Вып. VIII. С.- Петербургъ.

1910 — МИХѢЕВЪ: Отчетъ о поѣздкѣ въ сѣверо-западную Монголію и Урянхайскую землю. Изв. Главнаго Управленія Генеральнаго Щтаба. С.- Петербургъ.

1910 — J. G. GRANÖ: Beiträge zur Kenntnis der Eiszeit in der nordwestlichen Mongolei und einigen ihrer südsibirischen Grenzgebirge. Fennia 28. N:o 5. Helsingfors.

1910 — В. М. РОДЕВИЧЪ: Очеркъ Урянхайскаго края. Изданіе Управленія Внутр. Водн. Путей и Шосс. Дорогъ. Вып. XXIV. С.- Петербургъ.

1911 — В. А. ОБРУЧЕВЪ: Геологическій обзоръ золотоносныхъ районовъ Сибири. Часть II. Средняя Сибирь. Выпускъ I. Саянская область. С.- Петербургъ.

1912 — Я. С. ЭДЕЛЬШТЕЙНЪ: Геол. изслѣдов. произв. въ Ю. В. части Минусинскаго уѣзда въ 1910 г. Геол. изслѣдов. въ золотоносныхъ областяхъ Сибири. Енисейскій золотоносный районъ. Вып. XII. С.-Петербургъ.

1912 — В. М. РОДЕВИЧЪ: Урянхайскій край и его обитатели. Изв. И. Р. Г. О. Томъ XLVIII. С.-Петербургъ (Съ Картой).

1912 — J. G. GRANÖ: Die Nordwestmongolei. Eine geogr. Skizze. Z. Ges. f. Erdk. Berlin.

1912 — Н. СМИРНОВЪ: Растительные остатки изъ Урса штуфэ рѣки Улукемъ. Труды И. С.- Петербургскаго Общ. Естествоиспытателей. Томъ XXXV. Геологія и минералогія. С.- Петербургъ.

1913 — D. CARRUTHERS: Unknown Mongolia. A Record of Travel and Exploration in the northwestern Mongolia and Dshungaria. Vol. I—II. London.

1914 — Г. Е. ГРУМЪ ГРЖИМАЙЛО: Западная Монголія и Урянхайскій край. Томъ первый. Описаніе природы этихъ странъ. С.- Петербургъ.

1915 — ORJAN OLSEN: Til Jeniseis kilder. Den norske Sibirie-ekspeditionens reise 1914. Kristiania. (A popular description of the route travelled).

1915 — Б. М. ПОРВАТОВЪ: Мѣдныя руды Урянхая (Separat).

1915 — » » : Таловское мѣсторожденіе золота въ Усинскомъ пограничномъ округѣ. (Съ картой). Горн. и золотопр. Изв. Томскъ.

1916 — HENRIK PRINTZ: Die Cholorophyceen des südlichen Sibiriens und des Uriankailandes. — Contributiones ad floram Asiae interioris pertinentes. Edidit HENRIK PRINTZ. I. Det Kongl. Norske Videnskabers Selskabs Skrifter 1915. N:o 4. Trondhjem.

1917 — В. А. ОБРУЧЕВЪ: Обзоръ путешествій Д. А. КЛЕМЕНЦА по внутренной Азіи и ихъ географическихъ и геологическихъ результатовъ. Изв. Вост. Сиб. Отд. И. Р. Г. О. Томъ XLV. 1916 г. Посвящаетая памяти Д. А. КЛЕМЕНЦА. Иркутскъ.

1917 — В. Д. РЯЗАНОВЪ: О мѣсторожденіяхъ желѣзныхъ и мѣдныхъ рудъ близъ Абаканскаго завода. Рудный Вѣстникъ. Томъ II. 2. Москва.

1918 — М. А. УСОВЪ: Геологическое строеніе района Абаканскаго желѣзоруднаго мѣсторожденія, Енисейской губ. Томскъ.

1918 — M. D. ZALESSKY: Flore paléozoique de la Série d'Angará. Mém. du Comité Géologique. Nouv. Série. Livraison 174. Pétrograde.

1919 — HELGE G. BACKLUND: Om kemiska förändringar vid metamorfos. Geol. Fören. i Stockholm Förhandl. Band 41. Häfte 5. Stockholm.

1919 — А. П. ЕРМОЛАЕВЪ: Краткій отчетъ объ изслѣдованіяхъ въ Урянхайскомъ краѣ въ 1915—18 г. г. Сибирскіе Записки. № 4—5. Красноярскъ.

1919 — СЕРГЕЙ ОБРУЧЕВЪ: Тунгусскій угленосный бассейнъ. (Съ картой). Рудный Вѣстникъ за 1918 г. Москва.

1921 — H. HAUSEN: Tannu Ola. En kort geogr. karaktäristik av gränsryggen mellan övre Jenissejs flodområde och NW Mongoliet. Terra. Helsingfors.

1921 — HENRIK PRINTZ: The Vegetation of the Siberian-Mongolian Frontiers (The Sayansk Region). Published by Det Kongelige Norske Videnskabers Selskab. Trykt i Trondhjem. Contributiones ad floram Asiae interioris pertinentes. Edidit HENRIK PRINTZ. III. (A phytogeograpfical treatment of the country and a floral description. No maps but good pictures).

1923 — GUNNAR PEHRMAN: Über ein Nickeleisen aus Tannuola (Mongolei). Meddelanden från Åbo Akademis Geologisk-mineralogiska Institut. N:o 4. Repr. from Acta Academiae Aboensis. Math. et Phys. III. Åbo.

VII. Bibliography II.

(Concerning the Sayan Mountains as a whole except the Uriankhai Area. See above, BIBL. I).

1836 — КОВРИГИНЪ: Замѣчанія о геогностическомъ составѣ восточной части Саяна и отроговъ его, заключающихся въ верховьяхъ рѣкъ Иркута и Китоя. Горный Журналъ 1835. Кн. IX. Часть III. II. Геогнозія I. (Съ геологической картой части Саянскаго хребта въ верховьяхъ Китоя и Иркута). С.- Петербургъ.

1847 — E. HOFMANN: Reise nach den Goldwäschen Ost-Sibiriens. Beiträge zur Kenntnis des Russ. Reiches. Band XII. S:t Petersburg.

1855 — Н. МЕГЛИЦКІЙ: Отчетъ занятій за лѣто 1852 г. Горный Журналъ. Кн. IV. Часть II. С.- Петербургъ.

1855—56 — N. MEGLITZKY: Geognostische Skizzen von Ost-Sibirien. Verhandlungen der Kais. Russ. Mineralog. Gesellschaft. S:t Petersburg.

1861 — G. RADDE: Berichte über Reisen im Süden von Ostsibirien 1855—59. Beiträge zur Kenntnis des Russ. Reiches. Band XXIII. S:t Petersburg.

1864 — Путешествіе КРЫЖИНА отъ Бей-кема до Красноярска. Труды Сибирской Экспедицій. И. Р. Г. О. Общ. Математическій отдѣлъ. С.- Петербургъ.

1867 — П. КРОПОТКИНЪ: Поѣздка въ Окинскій Караулъ. Зап. Сиб. Отд. И. Р. Г. Общ. Томъ IX, X. Иркутскъ.

1871 — А. ЧЕКАНОВСКІЙ: Поѣздка къ горѣ Мунку Сардыкъ. Изв. Вост. Сиб. Отд. И. Р. Г. Общ. Томъ II. № 55. Иркутскъ.

1873. — И. Д. ЧЕРСКІЙ: Краткій отчетъ объ изслѣдованіяхъ, произведенныхъ лѣтомъ 1873 г. въ Китойскихъ и Тункинскихъ альпахъ (съ картой). Изв. В. С. О. И. Р. Г. Общ. Томъ IV. № 5. Иркутскъ.

1875 — П. КРОПОТКИНЪ: Общій орографическій очеркъ Вост. Сибири. Зап. И. Р. Г. Общ. Томъ V. С.- Петербургъ.

1875 — И. Д. ЧЕРСКІЙ: Еловскій отрогъ какъ связъ между Тункинскими альпами и Саяномъ. Изв. Сиб. Отд. И. Р. Г. Общ. VI. № 4. Омскъ.

1876 — » » : Отчетъ объ изслѣдов. Нижеудинской Пещеры. Изв. Сиб. Отд. И. Р. Г. О. Томъ VII. № 2—3. Омскъ.

1886 — И. Д. ЧЕРСКІЙ: О тектоникѣ и исторій развитія горной страны входящей въ составъ С. Зап. окрайны внутренной Азіи. Труды С.- Петерб. Общ. Естеств. Томъ XVII. Вып. 2. С.- Петербургъ.

1886 — Л. А. ЯЧЕВСКІЙ: Письмо изъ Мондинской мисс. стана отъ 5-го іюля 1887. Изв. В. С. Отд. И. Р. Г. Общ. Томъ XVII. № 3—4. Иркутскъ.

1887 — И. Д. ЧЕРСКІЙ: О послѣтретичныхъ образованіяхъ Сибири. Труды С.- Петерб. Общ. Естеств. Томъ XVIII. С.- Петербургъ.

1888 — Л. А. ЯЧЕВСКІЙ: Объ орографіи и геологіи Саянскаго хребта. Изв. В. С. О. И. Р. Г. Общ. Томъ XIX. № 1. Иркутскъ.

1893 — К. БОГДАНОВИЧЪ: Педварительный отчетъ о геолог. изслѣдованіяхъ, произведенныхъ въ Сибири въ 1892 г. Горный Жуналъ. С.- Петербургъ.

1894 — » » : Геол. изслѣдованія вдоль Сиб. Ж. Д. въ 1893 г. Средне-Сибирская горная Партія. Горный Журналъ. С - Петербургъ.

1894 — К. РИТТЕРЪ: Землевѣденіе Азіи. Восточная Сибирь. Саянское нагорье въ предѣлахъ Иркутской Губерній до Ю. З. оконочености озера Байкала, къ Ю. отъ Большого Сибирскаго Тракта. Сост. СЕМЕНОВЪ, ЧЕРСКІЙ и Ф. ПЕТЦЪ. С.- Петербургъ.

1895 — Н. ИЖИЦКІЙ: Геологическія работы въ Красноярскомъ и Канскомъ Округахъ Енисейской губерніи за 1893:й годъ. Горный Журналъ. Апрѣль. II. 1895 г. С.- Петербургъ.

1895 — К. БОГДАНОВИЧЪ: Матеріалы по геологіи и полезныя ископаемыя Иркутской Губерній. Горный Жуналъ. Томъ IV. Глава X. С.- Петербургъ.

1896 — Н. ИЖИЦКІЙ: Геологическія изслѣдованія бдоль Сибирской Ж. Д. въ 1894 г. Предварительный отчетъ. Геол. изслѣдованія по линіи Сиб. Ж. Д. Выпускъ III:й. С.- Петербургъ.

1896 — Л. А. ЯЧЕВСКІЙ: Геол. изслѣдованія въ сѣверной части Канскаго округа и въ полосѣ жел. дороги мѣжду Нижнеудинскомъ и с. Кимилтейскимъ. Геол. изслѣд. по линіи Сиб. Ж. Д. Выпускъ III:й. С.- Петербургъ.

1896 — В. С. РЕУТОВСКІЙ: Золотоносный районъ средняго теченія р. Большого Абакана. Съ геологической Картой. Томскъ.

1898 — ДЕ ГЕННИНГЪ МИХЕЛИСЪ: Въ сѣверной Монголіи. Изв. В. С. Отд. И. Р. Г. Общ. Томъ XXIX. № 3. Иркутскъ.

1899 — Л. А. ЯЧЕВСКІЙ: Алиберовское мѣсторожденіе графита на Ботогольскомъ гольцѣ. Геол. изслѣд. и. т. д. по Сибирск. Ж. Д. Вып. XII. С.- Петербургъ.

1899 — И. П. ТОЛМАЧЕВЪ: Къ вопросу о ледниковомъ періодѣ въ Сибири. Труды С.- Петербургск. Общ. Естеств. Протоколъ. XXX. С.- Петербургъ.

1899 — Ѳ. БРУСНИЦЫНЪ: Геол. изслѣдованія и радвѣдки въ вост. части Енисейской Губ. въ 1897 г. Геол. изслѣдов. etc. по линіи Сиб. Ж. Д. Выпускъ XIII:й. С.- Петербургъ.

1899 — E. VON TOLL: Beiträge zur Kenntnis des Sibirischen Cambrium. I. Зап. Имп. Академіи Наукъ. VIII Сер. С.- Петербургъ.

1903 — С. П. ПЕРЕТОЛЧИНЪ: Физическо-географическій очеркъ Коссогола. Труды Казанск. Ощ. Естеств. Томъ XXXVIII. Вып. I. Казань.

1905 — В. Л. КОМАРОВЪ: Поѣздка въ Тункинскій Край и на озеро Коссоголъ въ 1902 г. Изв. Имп. Р. Геогр. Общ. Томъ XLI. Вып. I. Петроградъ.

1909 — И. П. ТОЛМАЧЕВЪ: Геологическое описаніе вост. половины 15:го и Ю. З. четверти 16:го листа VIII ряда 10-верстной топографической карты Томской губерній. Труды Геол. Части Кабинета ЕГО ИМП. ВЕЛИЧЕСТВА. Томъ VII. С.- Петербургъ.

1909 — А. ЛЬВОВЪ и Г. КРОПАЧЕВЪ: Краткій отчетъ о результатахъ излѣдованій Аршана. Извѣстія Вост. Сиб. Отд. Имп. Р. Геогр. Общ. Томъ XL (съ схематической геол. картой Тункинской долины). Иркутскъ.

1909 — В. ДОРОГОСТАЙСКІЙ: Карта озера Коссогола (съёмки 1905, 07, 08). Отд. изд. Вост. Сиб. Отд. И. Р. Г. Общ. Иркутскъ.

1911 — В. А. ОБРУЧЕВЪ: Геологическій обзоръ золотоносныхъ районовъ Сибири. 4. Красноярскій районъ. Золото и платина. № 4. С.- Петербургъ.

1913 — JOH. AHLBURG: Die neueren Fortschritte in der Erforschung der Goldlagerstätten Sibiriens. Zeitschrift für praktische Geologie. März—April. Berlin.

1915 — Г. ФРЕДЕРИКСЪ: Предварительный отчетъ о геологическихъ изслѣдованіяхъ въ Иркутской губерній лѣтомъ 1914 г. XXXI. Извѣстія Геологическаго Комитета. Томъ XXXIV. № 9. Петроградъ.

1915 — П. И. ПРЕОБРАЖЕНСКІЙ: Краткій отчетъ работъ. Отчетъ о состояніи и дѣятельности Геологическаго Комитета въ 1914 г. XII. Иркутская Область. Разд. 17. Изв. Геол. Ком. XXXIV. № 1. Петроградъ.

1920 — И. Р. МОЛОДЫХЪ: Селенга въ предѣлахъ Монголіи. Вып. 1. И. П. ТОЛСТИХИНЪ: Геологія (схема маршрута и общій обзоръ). Съ геол. разрѣзомъ. Ленобайкалскій Округъ Путей Сообщенія. Иркутскъ. (Comprises also a part of the Kossogól rayon.)

VIII. Maps and profiles.

(Concerning the Upper Yenissei Area).

1836 — J. KLAPROTH: Carte de l'Asie Centrale dressée d'après les Cartes levées par ordre de l'Empéreur Khian-Loung, par les Missionaires de Peking, et d'après un grand nombre de notions extraites et traduites de livres chinois. Paris.

1855 — ЩЕЧИЛИНЪ: Карта южной части Енисейской Губерніи, четырёхъ округовъ, составлена въ Управленій Генеральнаго Штаба Восточно-Сибирскои Арміи. Масштабъ 25 в. въ англ. дюймѣ.

1864 — К. Г. ШВАРЦЪ: Карта рѣчныхъ областей Амура, Ю. части Лены и Енисея и острова Сахалина. [Карта Ю. части Восточной Сибири и пограничныхъ владеній Китая]. Изданіе Имп. Русск. Географическаго Общества. Масштабъ 40 в. въ англ. дюймѣ.

1875 — П. КРОПОТКИНЪ: Гипсометрическая карта Минусинскаго, Красноярскаго и части Канскаго округовъ. (Гидрогр. сѣть и названія мѣстностей по картѣ г. ШВАРЦА.) Масштабъ 40 в. въ англ. дюймѣ.

1875 — КАРТА Ю. ПОЛОВИНЫ ВОСТ. СИБИРИ, ЧАСТИ МОНГОЛІИ etc. Масштабъ 1 : 6,720,000. Прилож. въ Зап. по Общ. геогр. В. С. О. И. Р. Г. О. Томъ V. Иркутскъ.

1881 — П. А. РАФАИЛОВЪ: Карта С. З. Монголій по съемкѣ 1876—77. Масштабъ 50 в. въ дюймѣ. Приложена къ труду ПОТАНИНА, Очерки С. З. Монголій, Вып. I.

1883 — КАРТА С. З. МОНГОЛІИ ПО ПОСЛѢДНЫМЪ СВѢДѢНІЯМЪ. Масштабъ 5 в. въ д. Приложена къ труду ПОТАНИНА. Очерки С. З. Монголіи. Выпускъ III.

1903 — КАРТА КЪ ПУТЕШЕСТВІЮ КРЫЛОВА ВЪ УРЯНХАЙСКУЮ ЗЕМЛЮ, въ 1892 г. (1903). Масштабъ 1 : 1,680,000.

1903 — РАЗРѢЗЫ УРЯНХАЙСКОЙ ЗЕМЛИ по маршрутнымъ линіямъ. Горизонт. масштабъ 25 в. въ д. Верт. увеличенъ въ 30 разъ. Приложены къ труду КРЫЛОВА (1903).

1903 — МАРШРУТНЫЯ СЪЕМКИ КЪ ПУТЕШЕСТВІЮ КРЫЛОВА ПО УРЯНХАЙСКОЙ ЗЕМЛѢ. Масштабъ 1:168,000.
№1. Переходъ Тапса́-Бейхемъ (Заимка Сафьянова).
№2. Верхнее теченіе р. р. Хамсары и Азаса.
№3. Верхнее теченіе р. Ій-сука.
№4. Верховье р. Систыг-кхема (Систихема).

1907 — КАРТА Ю. ЧАСТИ МИНУСИНСКАГО ГОРНАГО ОКРУГА. Масштабъ 1:24,000. (Copy of the Government colonization map?)

1912 — Я. С. ЭДЕЛЬШТЕЙНЪ: Геолог. Карта Ю. В. части Минусинскаго уѣзда. Масштабъ 5 верстъ въ англ. дюймѣ. Прилож. къ труду (1912).

1910 — В. М. РОДЕВИЧЪ: Судоходная карта рѣки Енисея. Изд. Мин. Путеи Сообщенія. Гл. Упр. Внутренныхъ Водныхъ Путей и Шоссейныхъ Дорогъ. С.- Петербургъ. Часть I. Верхнее теченіе Енисея. Масштабъ 1:10,000.

1912 — В. М. РОДЕВИЧЪ; Карта бассейна верхней части рѣки Енисея. Сост. по съемкѣ Парти Мин. Путей Сообщ. по изслѣдованію системы Верхняго Енисея 1907—1910 гг. и по нов. даннымъ географической литературы 1890—1910 г. г. etc. Масштабъ 40 в. въ англ. дюймѣ. (The best existing map of the region). 1 :1,680,000.

1915 — ГЕОЛОГИЧЕСКАЯ КАРТА ЧАСТИ УСИНСКАГО КРАЯ. Сост. Б. М. ПОРВАТОВЫМЪ. Масштабъ 2 в. въ д.

1913—16 — КАРТА Ю. ПОГРАНИЧНОЙ ПОЛОСЫ АЗІАТСКОЙ РОССІИ. Изданіе Военно — Топограф. Отдѣленія Генеральнаго Штаба. Масштабъ 40 в. въ д. (1 :1,680,000).

Explanatory Notes to the accompanying Maps.

The three itinerary maps accompanying this paper are based on measurements made during quite rapid traverses of the ground. As instrumental outfit only compass and aneroid were used. The distances in the routes were estimated by time observations during the ride. In Tangnu-Ūla the author got 1918 some occasions to work with diopter and table of measurement and make an areal croquis of some parts of the region. Corrections have been made on nearly all aneroide observations of the maps 2 and 3, while on the map 1 the western half (W of Sosnoffka) the heights have been calculated without corrections of the data obtained. A barograph station somewhere in the villages (in the lowland) would, however, have been of little value, because in Tangnu-Ūla there are very frequently atmosphaeric disturbances in summertime, accompanied by rain and hail, seldom reaching the lowland.

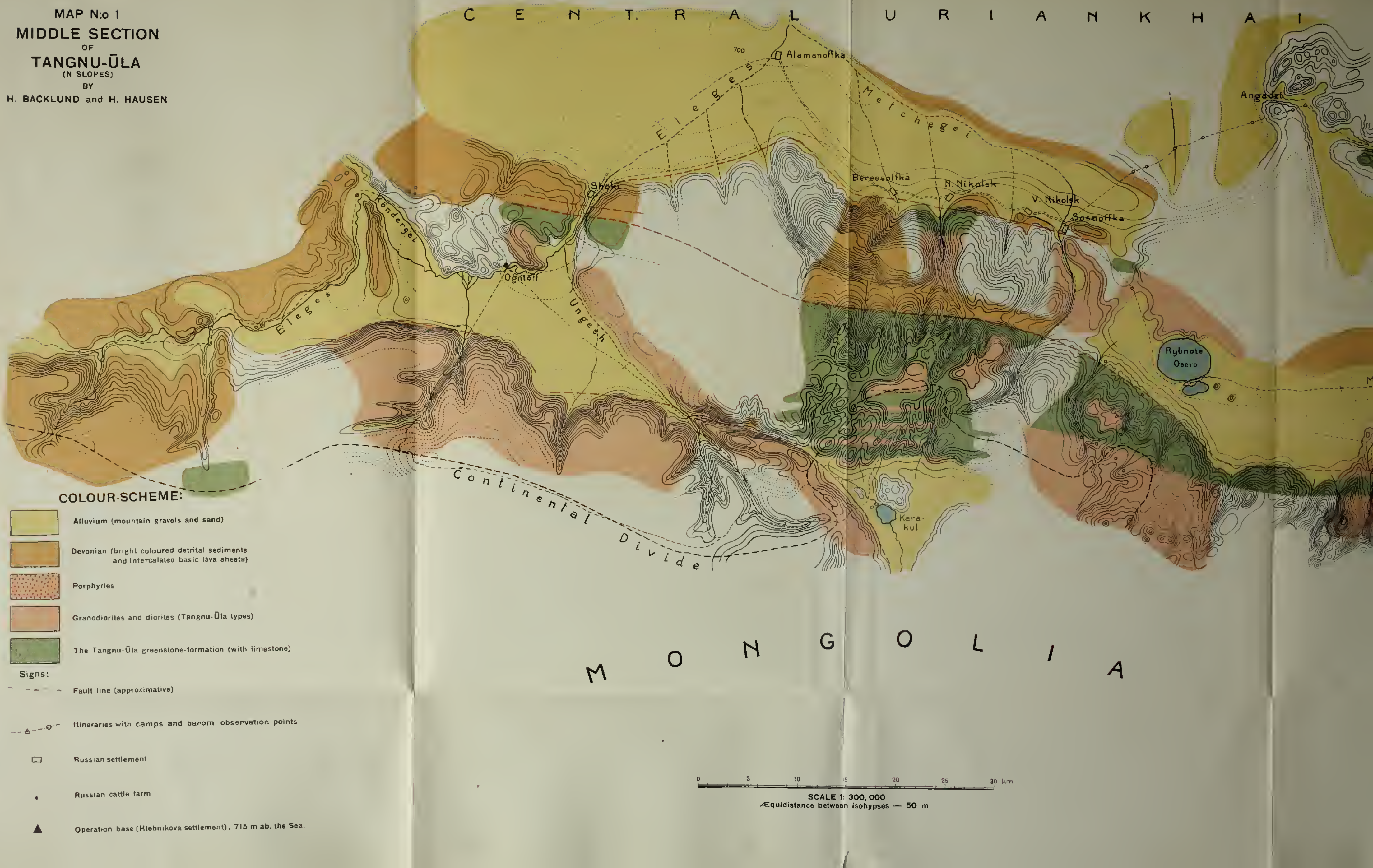
The geological limits in the map n:o 1 are quite schematized due to the scarcity of routes.

Correction to the Maps:

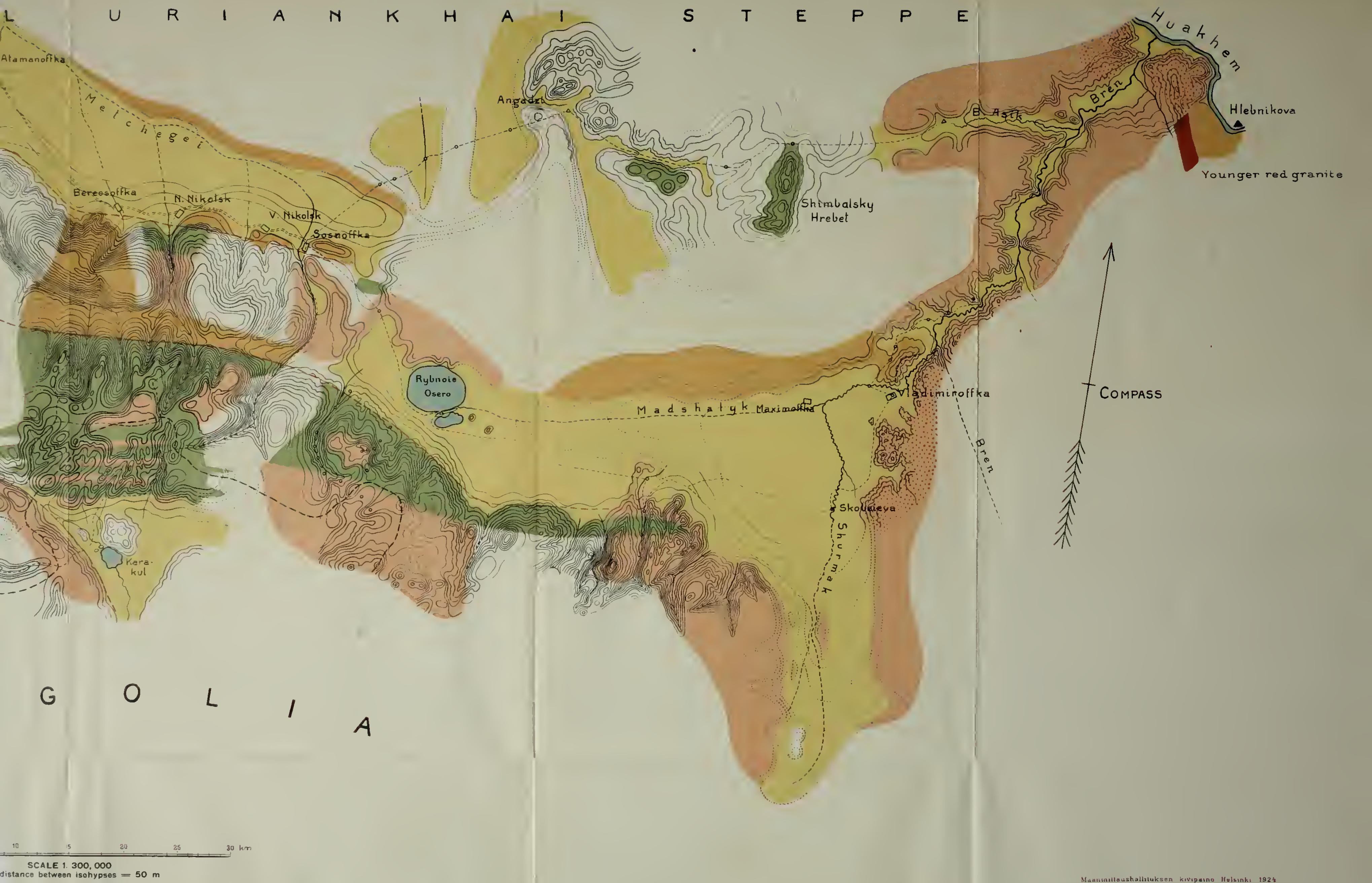
Instead of »ACTA GEOGRAPICA» (upper corner to the right) read: »ACTA GEOGRAPHICA».

MAP N:o 1

MIDDLE SECTION
OF
TANGNU-ŪLA
(N SLOPES)
BY
H. BACKLUND and H. HAUSEN



CENTRAL URIANKHAI
MONGOLIA
Atamanoffka
700
Eleges
Metchegei
Angadzi
Shoki
Konderget
Ognioff
Ungesh
Bereosoffka
N. Nikolsk
V. Nikolsk
Sosnoffka
Rybnoie Osero
Kara-kul
Continental Divide
COLOUR-SCHEME:
Alluvium (mountain gravels and sand)
Devonian (bright coloured detrital sediments and intercalated basic lava sheets)
Porphyries
Granodiorites and diorites (Tangnu-Ūla types)
The Tangnu-Ūla greenstone-formation (with limestone)
Signs:
Fault line (approximative)
Itineraries with camps and barom. observation points
Russian settlement
Russian cattle farm
Operation base (Hlebnikova settlement), 715 m ab. the Sea.
0
5
10
15
20
25
30 km
SCALE 1: 300, 000
Æquidistance between isohypses = 50 m

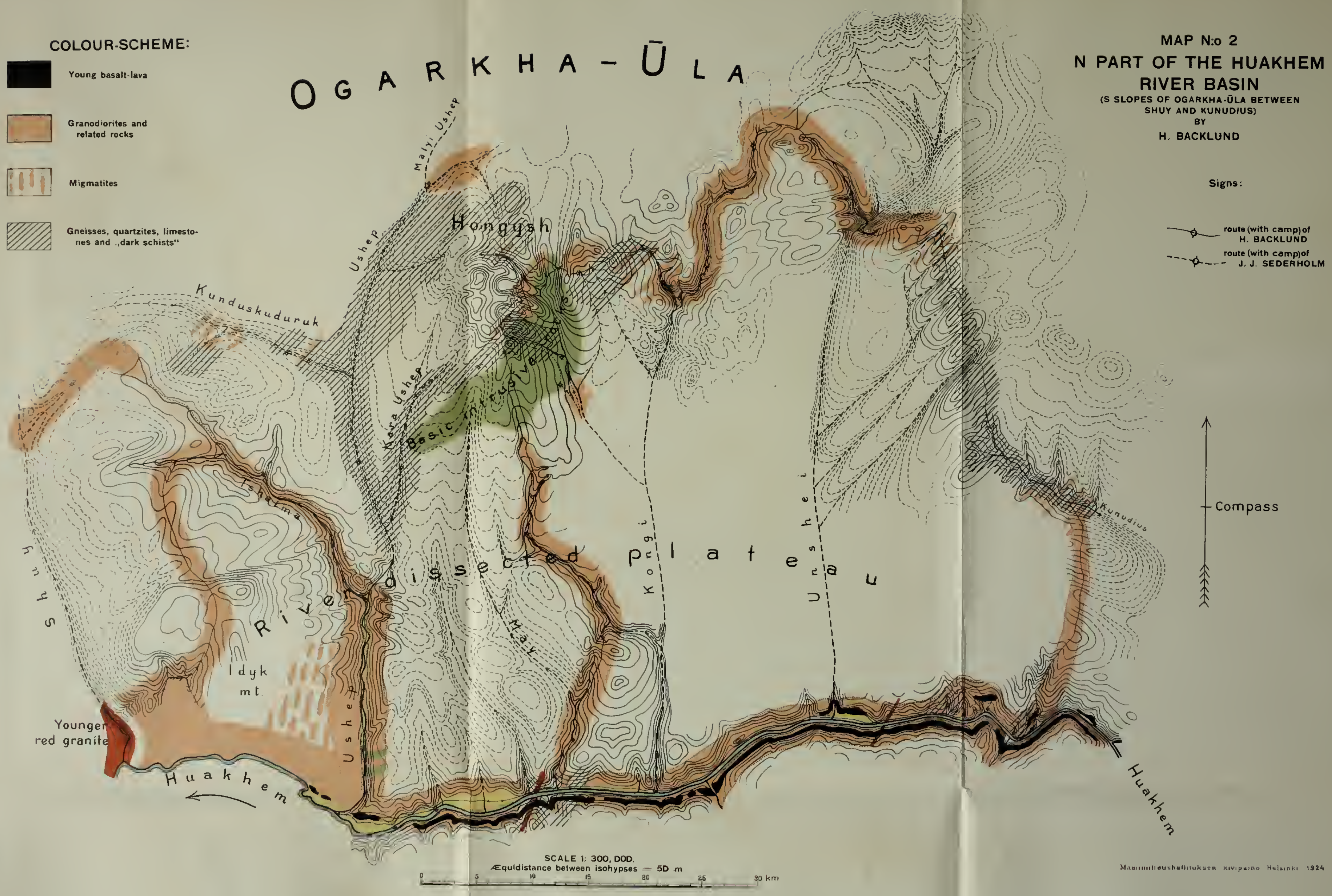


Maanmittaushallituksen kivipaino Helsinki 1924

MAP N:o 2

N PART OF THE HUAKHEM RIVER BASIN

(S SLOPES OF OGARKHA-ŪLA BETWEEN SHUY AND KUNUDIUS)
BY
H. BACKLUND



Maanmittaushallituksen kivipaino Helsinki 1924

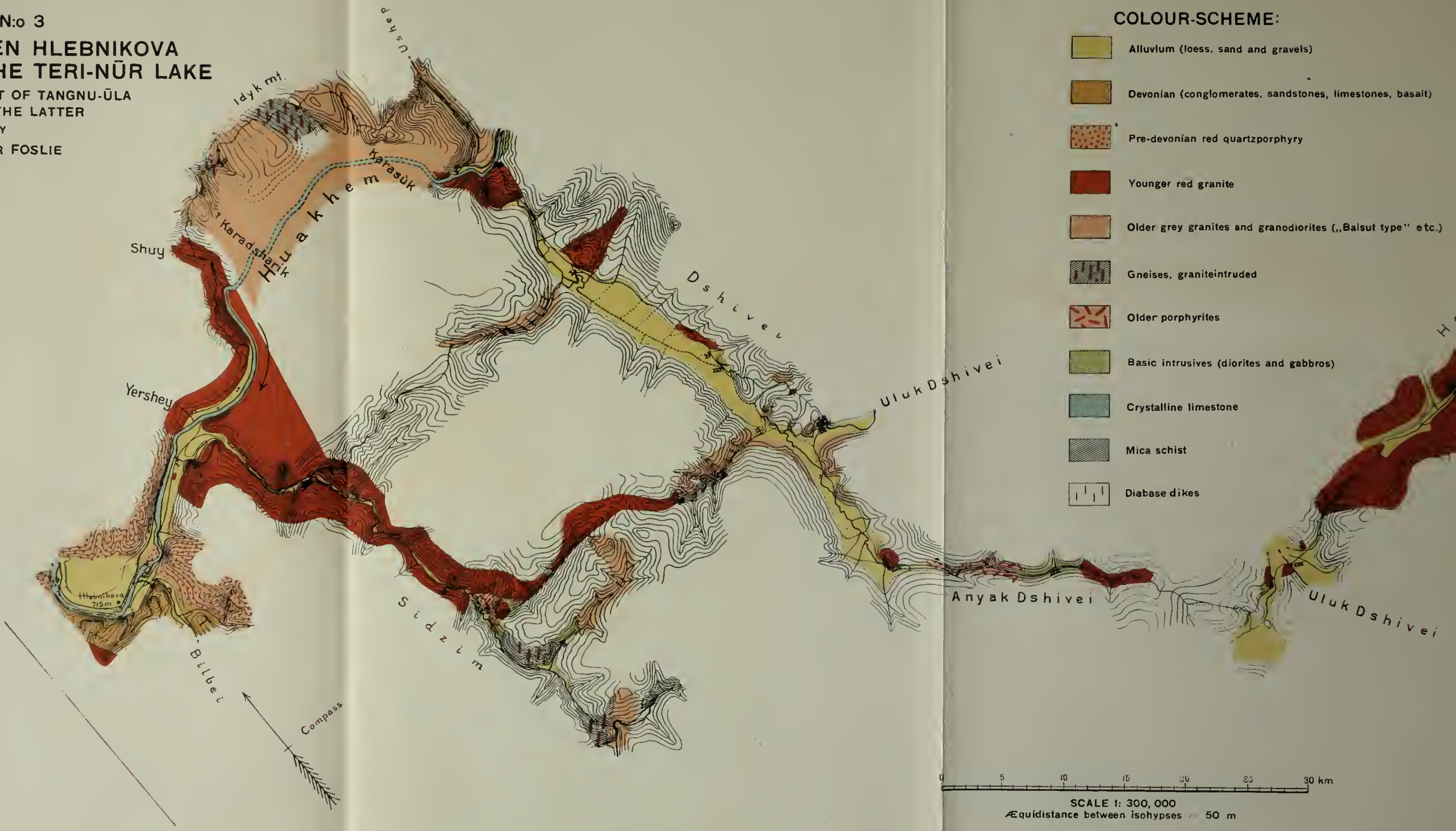
MAP N:o 3

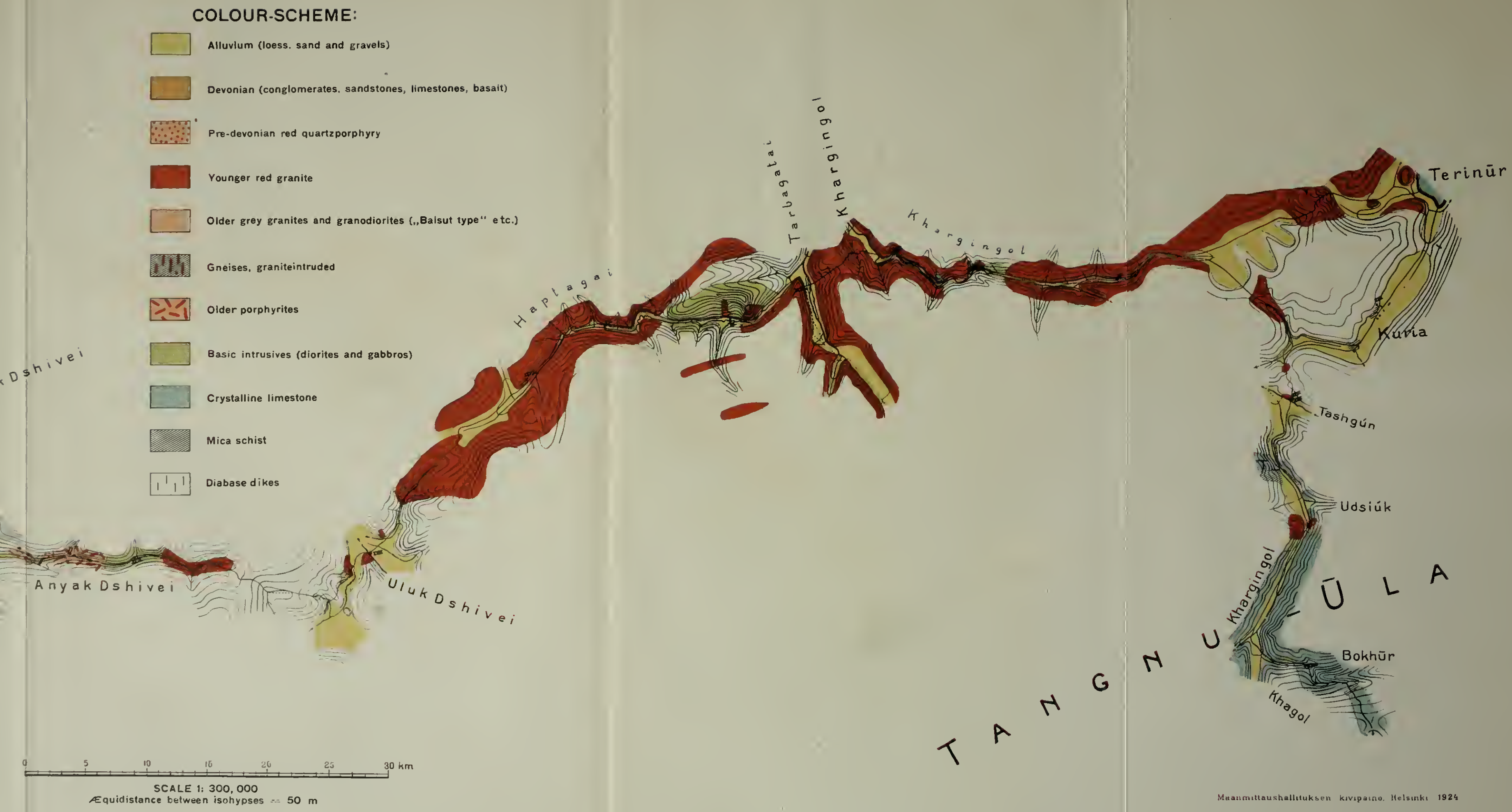
ROUTE BETWEEN HLEBNIKOVA (HUAKHEM) AND THE TERI-NŪR LAKE

AND THE N CREST OF TANGNU-ŪLA SW FROM THE LATTER

BY

STEINAR FOSLIE





Maanmittaushallituksen kivipaino, Helsinki 1924

ACTA GEOGRAPHICA 1, N:o 2

DIE FORSCHUNGSGEGENSTÄNDE DER GEOGRAPHIE

VON

J. G. GRANÖ

VORTRAG, GEHALTEN IN LUND, KOPENHAGEN UND STOCKHOLM
IM NOVEMBER UND DEZEMBER 1926

HELSINKI — HELSINGFORS
1927

HELSINGFORS
1927
DRUCK VON A.-G. F. TILGMANN

Die von natürlichen Grenzen umgebenen Teile der Erdoberfläche wurden schon von den Bahnbrechern der wissenschaftlichen Geographie als Einheiten von zentraler Bedeutung angesehen. So betonten die Vertreter der s. g. reinen Geographie im Anfang des 19. Jahrhunderts die Bedeutung der »natürlichen Länder», die nicht von wechselnden politischen Machtverhältnissen abhängig waren, RITTER sprach gern von Land- oder geographischen Individuen und dieselben Ansichten vertraten MARTHE[1]), BECK[2]) und MATZAT[3]) in ihren klassischen, heute leider vergessenen Arbeiten.

Dasselbe Ziel, die Begrenzung, allseitige wissenschaftliche Erforschung und Erkenntnis der regionalen Einheiten, der Komplexe, erstrebt auch die Geographie unserer Tage, besonders die s. g. Landschaftskunde und die regionale oder spezielle Geographie, mögen nun diese Gebiete natürliche Länder, geographische Individuen, Landschaften, Regionen oder Milieus genannt werden.

Wenn ich die Gesichtspunkte darzulegen versuche, die ich in bezug auf das Objekt und die Methode der geographischen Forschung schon früher in einigen finnisch und estnisch veröffentlichten Aufsätzen[4]) entwickelt und in meiner akademischen Lehrtätigkeit durchzuführen gesucht habe, bin ich mir lebhaft bewusst, dass vieles von meinen Ausführungen schon früher von andern hervorgehoben ist. Die folgende Darstellung möge als ein Beitrag von finnischer Seite aufgefasst werden zur Klärung des augenblicklich vielleicht wichtigsten methodischen Problems in der Geographie, als ein anspruchsloser Versuch unsere umfangreiche und nicht scharf genug bestimmte Wissenschaft mehr zu begrenzen und genauer zu definieren.

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[1]) F. MARTHE, Begriff, Ziel und Methode der Geographie. Zeitschr. d. Ges. f. Erdk. zu Berlin, XII, 1877.

[2]) L. C. BECK, Die Aufgaben der Geographie mit Berücksichtigung der Handelsgeographie. Jahresber. d. Württemb. Vereins f. Handelsgeogr., I—II, 1884. Ausführlich referiert von H. WAGNER in Geogr. Jahrb., X, 1884.

[3]) H. MATZAT, Methodik des geogr. Unterrichts. Berlin 1885.

[4]) »Die landschaftlichen Einheiten Estlands» (Estnisch, mit deutschem Referat, Loodus 1922, Tartu), »Maisematieteen tehtävät ja maiseman muotojen järjestelmä» (Terra 1924, Helsinki), »Ympäristö maantieteen tutkimusesineenä» (Terra 1924), «Maantieteen rajat» (Terra 1925) und »Morfologia ja ympäristötiede» (Terra 1926).

Wie von Philosophen hervorgehoben ist,¹) könnte man das Weltall in Teile, die verschiedene Grössenkategorien verträten, — in ein sozusagen treppenförmiges Grössensystem einteilen, wo der oberste Absatz vielleicht den ungeheueren Sternenwelten der Milchstrasse, die folgenden der Reihe nach den Sternbildern mit ihren unzähligen Fixsternen und Sonnensystemen, unserem Sonnensystem, weiter der Erde, den Kontinenten und Ozeanen, den Wolken, Bergen, Flüssen, Pflanzen, Tieren, dem Menschen, sowie schliesslich der Kleinwelt des Mikroskops entsprechen. In dieser Grössengruppierung müssten — so stelle ich mir vor — die nächste Umgebung des Menschen, das Milieu oder die Umwelt, als Einheit aufgefasst und die Gebiete, die in dieser Hinsicht einheitlich sind, einen wichtigen Absatz bilden.

Die in Frage stehenden Grössenkategorien, zwischen denen der praktische Verstand gewisse im Raume bestimmbare, also topologische Grenzen festgelegt hat, haben, wie natürlich ist, trotz ihrer qualitativen Heterogenität in gewissem Grade auf das System der Wissenschaften eingewirkt. Diese Frage interessiert uns in diesem Zusammenhange nur insofern, als die Geographie, die von manchen als die Raumwissenschaft 'ex professo' angesehen wird, unter diesen vielen Grössenkategorien des Weltalls ihr eigentliches Forschungsobjekt finden könnte.

Die Erde in ihrer Ganzheit oder die Erdoberfläche im weitesten Sinne des Wortes als Gegenstand geographischer Forschung hat stets warme Anhänger gefunden, und wenn es uns gelingt in der Praxis mit den genannten Komplexen als Objekt die Idee der Einheit durchzuführen, dürften wohl kaum noch ernsthafte Einwände gegen einen solchen Standpunkt erhoben werden können.

Richtiger wäre indes, glaube ich, die Umgebung des Menschen oder das Milieu als Ausgangspunkt zu wählen, also einige Treppenstufen niedriger in dem obenerwähnten Grössensystem zu beginnen, denn damit kommen wir unmittelbar zu dem, was die meisten unter uns Geographen als das Zentralproblem unserer Wissenschaft ansehen.

Das Milieu ist allerdings eine ebenso heterogene Ganzheit wie die Erde oder die Erdoberfläche, doch wird der Wert unserer Wissenschaft und unserer Forschungen keineswegs dadurch verringert, dass andere Disziplinen mehr oder minder grosse Teile unseres Forschungsgegenstandes zu ihrem eigenen

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¹) Vgl. E. BECHER, Naturphilosophie. Die Kultur d. Gegenwart, III, 7. Leipzig 1914. S. 206.

gemacht haben, und es schadet der Geographie auch keineswegs, dass das Milieu einen Teil des umfangreicheren Forschungsobjektes anderer Wissenschaften bildet. Das trifft ja für alle Wissenschaften zu, die mit der Wirklichkeit sich beschäftigen.

Ich will nun keineswegs behaupten, dass wir Geographen ein Alleinrecht an dem Milieu als Forschungsobjekt hätten oder dass Arbeitsverteilung auf diesem Gebiete menschlicher Forschung unnötig wäre. Im Gegenteil. Ohne Spezialisierung geht es auch hier nicht. Aber wir müssen danach streben, dass die Arbeitsverteilung rationell ist. Die Einheit der Umwelt, deren richtige Auffassung uns als höchstes Arbeitsziel vorschwebt, darf nicht durch unrichtige Gliederung oder weniger glückliche Rollenverteilung gefährdet werden.

Was ist nun eigentlich das Milieu oder die Umwelt?

Sicherlich nicht nur die Ganzheit, die wir mit unseren Sinnen wahrnehmen, sondern auch unsere soziale Umgebung. Es fragt sich nur, ob das alles zur Geographie gehört. Wenn wir bedenken, wie begrenzt unsere Fähigkeiten sind und wie wenig an Wissen wir unseren jungen Geographen geben können, und wenn wir weiter die Arbeitsverteilung berücksichtigen, die in der Auskristallisierung begriffen ist, so wird unsere Antwort verneinend. Die unmittelbar wahrnehmbare Umwelt ist ja hauptsächlich der Gegenstand unserer Untersuchungen gewesen und es erscheint mir natürlich, dass sie auch in Zukunft der eigentliche Forschungsgegenstand der Geographie bleiben muss. Die soziale Umwelt gehört meines Erachtens eher zur Soziologie, dieser lebenskräftigen jungen Wissenschaft, die sicherlich mehr Voraussetzungen als die Geographie hat diesen Komplex des menschlichen Gesellschaftslebens zu deuten.

Das sinnlich Wahrnehmbare und die soziale Umwelt bilden allerdings, wie bereits hervorgehoben wurde, eine Einheit. Eine Wissenschaft von dieser Einheit wäre, um einen von amerikanischen Geographen in teilweise anderer Bedeutung geschaffenen Ausdruck zu verwenden, Anthropoökologie,¹) eine Art wissenschaftlicher Heimatkunde. Diese Ökologie liesse sich auf Grund des oben Gesagten am zweckmässigsten durch Zusammenarbeit zwischen Geographen und Soziologen pflegen.

Der Teil der menschlichen Umwelt, den wir mit unseren Sinnen wahrnehmen, oder die s. g. Naturumgebung, ist also meines Erachtens unser Forschungsgegenstand. Darum nenne ich ihn im folgenden das geographische Milieu oder die geographische Umgebung. Es ist unsere Aufgabe durch eingehende Analyse und zweckentsprechende Syn-

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¹) HARLAN H. BARROWS, Geography as Human Ecology. Annals of the American Geographers, XIII, 1923.

these das Wesentliche in diesem direkt wahrnehmbaren Komplex der Eigenschaften aufzuzeigen. Wir sind bei dieser Arbeit Naturforscher, Natur aber sind für uns nicht nur die unbewohnten Wüsten und Urwälder oder die weiten Flächen der Ozeane, sondern auch die Siedlungen, die Dörfer und Städte. Und wenn wir das Wesen und die Genesis der geographischen Umwelt zu erforschen unternehmen, dürfen wir nicht nur bei dem stehen bleiben, was wir mit unseren Sinnen wahrnehmen, ebenso wenig wie ein Naturforscher mit Pflanzen und Tieren als Forschungsobjekt unterlassen darf als wichtige physiologische oder genetische Faktoren auch solche zu betrachten, die keineswegs zur Botanik oder Zoologie gehören. Mit Recht sagt BECHER[1]: »Wenn wir die Körperwelt als Gegenstand der Naturforschung bezeichnen, so wollen wir letzterer keineswegs die Berechtigung absprechen, nichtkörperliche Weltfaktoren zu berücksichtigen. Wo immer nicht materielle Faktoren für das körperliche Geschehen von Bedeutung sind, muss die Naturforschung sie in Betracht ziehen.»

Dadurch dass wir die Naturumgebung als Forschungsgegenstand der Geographie bezeichnet haben, ist auch das Gliederungsprinzip unserer Arbeit gegeben, und zwar sowohl in qualitativer wie quantitativer Hinsicht. Qualitativ analysieren wir das Material am deutlichsten in der Ordnungsfolge unserer äusseren Sinne. Wir haben in erster Linie die Gesichtsempfindungen, Gehörempfindungen u. s. w. zu beachten und erst in zweiter Linie das Material — Felsgrund, Wasser, Vegetation u. a. —, woraus die Ganzheit zusammengesetzt ist. Quantitativ ist die Entfernung im Raum wie in der Zeit von sehr grosser Bedeutung. Von der Entfernung im Raum hängen die Ausbreitung, die Dimensionen und die Intensität, von der Entfernung in der Zeit die grössere oder geringere Bedeutung der Erscheinung im Komplex ab.

Das wichtigste in dem geographischen Milieu ist ohne Zweifel das, was wir sehen, die Welt des Lichtes, der Farben und Formen. Diese sichtbare Ganzheit wollen wir Gesichtsfeld nennen. Aber auch die Gehör-, Geruchs- und Gefühlsempfindungen müssen in dem Grade, wie sie von wesentlicher Bedeutung sind, bei einer vollständigen geographischen Darstellung beachtet werden. Ein Teil dieser Empfindungen, nämlich alle Gehör- und Geruchsempfindungen können in Wirklichkeit als Eigenschaften der uns umgebenden Luft betrachtet und unter dem Begriff geographisches Medium zusammengefasst werden. Schliesslich erhalten wir durch Vermittlung gewisser Gefühls- und Tastempfindungen Kenntnis von der Unterlage, dem geographischem Substrat, auf dem wir uns bewegen.

Mit anderen Worten: Wir können das geographische Milieu in qualitativer

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[1] a. a. O., S. 14.

Beziehung in drei Hauptteile einteilen, nämlich das Gesichtsfeld, das Medium und das Substrat.

Das Quantitative wird, wie schon gesagt wurde, von uns teils als Grösse, teils als Intensität aufgefasst, mit der Entfernung als bestimmendem Faktor nach beiden Seiten. Man könnte auf der Karte um die Gegenstände, die durch eine gewisse Empfindung charakterisiert werden, Kurven ziehen, die angeben würden, wie die betreffende Empfindung abnimmt, je weiter man sich von dem Gegenstand entfernt. Die Gesichtsempfindungen bilden in diesem Fall indessen eine Gruppe für sich, denn nur sie werden von uns direkt und sicher in unserer Umgebung lokalisiert. Beim Gesichtsfeld können wir von einer Nahumgebung und einer Fernumgebung sprechen, wogegen die anderen Empfindungen, auch die Gehörempfindungen, sich am besten als Nahempfindungen auffassen lassen, deren Ursprung wir nicht direkt, sondern auf Grund gesammelter Erfahrung und mit Hilfe des Gesichtssinnes lokalisieren. Wir haben demnach rein quantitativ eine Nahumgebung und eine Fernumgebung (oder ein Nahmilieu und ein Fernmilieu), diese lassen sich aber nur mit dem Gesichtssinne unterscheiden.

Das geographische Milieu wird in so ausgesprochener Weise von den Gesichtsempfindungen beherrscht, dass wir kaum einen methodischen Fehler begehen, wenn wir uns bei der Charakterisierung geographischer Komplexe in erster Linie an das halten, was wir sehen, im besondern was wir in den weiter gelegenen Teilen des Gesichtsfeldes für morphographisch wesentlich halten; die wir in grösserer Ausdehnung mit dem Blick beherrschen und deren Erfassung nicht nur die jederzeit notwendige Generalisierung, sondern auch die Erkenntnis dessen, was für das Gebiet bezeichnend ist, erleichtert. In der »bestehenden» Welt der Formen orientieren wir uns vorzugsweise und ihre Züge können wir im Raum leicht bestimmen und wiederfinden.

Das Studium der entlegeneren Teile des Gesichtsfeldes oder speziell ihrer Morphographie genügt jedoch nicht. Wir erhalten allerdings dadurch eine sichere Vorstellung vom Objekt als Einheit, wir gewinnen eine Definition und Begrenzung für dasselbe, aber die Kenntnis seines geographischen Aufbaues setzt auch eine eingehende Erfassung der Nahumgebung als eines Komplexes des dem Beschauer am nächsten gelegenen Teiles des Gesichtsfeldes sowie des Mediums und Substrats, also in erster Linie der Eigenschaften, die wir mit Hilfe des Gefühls- und Tastsinnes kennen lernen, voraus.

SAPPER¹) und GRADMANN²) haben allerdings betont, dass in gewissen Fällen

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¹) K. SAPPER, Geologischer Bau u. Landschaftsbild. Braunschweig 1917. S. 4—5.

²) R. GRADMANN, Pflanzen und Tiere im Lehrgebäude der Geographie. Geogr. Abende, 4. Berlin 1919. S. 7—8.

die Gehör- und Geruchsempfindungen für die geographische Charakterisierung der »Landschaft» von grosser Bedeutung sind. Da es sich hier aber um Eigenschaften bei dem geographischen Komplexe handelt, die meist stark wechseln und auf begrenzten Gebieten auftreten, lassen sich die betreffenden Empfindungen doch wohl weder den Gesichts- noch den Gefühlsempfindungen gleichstellen. Ausserdem dürften die Geruchsempfindungen bei verschiedenen Personen so stark divergieren, dass die Beurteilung ihrer Bedeutung leicht subjektiv werden kann.

Wir kommen damit zu einer Frage von grosser Wichtigkeit: wo liegt die Grenze zwischen Nah- und Fernumgebung? Aus dem Gesagten dürfte hervorgehen, dass eine solche Grenze, wenn sie vorhanden ist, nur im Gesichtsfeld festgelegt werden kann.

Vom anthropozentrischen Standpunkt aus liesse sich die scheinbare Entfernung zwischen dem Beschauer und dem freien Horizont in zwei gleich grosse Teile zerlegen. Wir würden dann, wie FILEHNE[1]) nachgewiesen hat, finden, dass diese Grenzlinie beim erwachsenen Menschen in einer Entfernung von nur 20 m liegt. Der ganze Abstand zwischen Horizont und Beschauer beträgt ungef. 5 km.

Eine solche Grenze ist jedoch wenig natürlich. Wichtiger ist, dass wir nur den Komplex von Gegenständen plastisch oder stereoskopisch auffassen, die wir in unserer nächsten Umgebung haben, dass wir m. a. W. hier die Tiefe des Gesichtsfeldes in der Richtung von uns zum Horizont richtig auffassen, weiter dass der nächste Teil des Gesichtsfeldes sich um uns als deutliche Fläche ausbreitet und schliesslich dass wir die Gegenstände in unserer Nähe als in ihrer »richtigen» oder »wirklichen» Grösse zu sehen glauben, während weiter entfernt gelegene Gegenstände unserer Ansicht nach kleiner aussehen, eine »scheinbare» Grösse haben. Durch FILEHNES Untersuchungen[2]) wissen wir, dass die Grenze zwischen »wirklicher» und »scheinbarer» Grösse verschieden weit von uns entfernt liegt, je nach dem Durchmesser des Gegenstandes. Ein menschliches Gesicht, also ein sehr wichtiger Gegenstand in unserer Nahumgebung, mit einem Durchmesser von ungef. 20 cm, würde diese seine »kritische Grenze» in ca. 23 m Abstand haben. Wir können sagen, dass die Objekte, die in der Nahumgebung bestimmend sind, ihre kritische Grenze zwischen 20 und 100 m haben.

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[1]) W. FILEHNE, Der absolute Grösseneindruck beim Sehen der irdischen Gegenstände und der Gestirne. Arch. f. Anat. u. Physiol., Physiol. Abt., 1917. S. 210.

[2]) a. a. O., S. 199.

Weiter ist die Luftperspektive zu beachten. Die Luft ist bekanntlich weder vollkommen farblos noch vollständig durchsichtig. Weiter entfernt gelegene Gegenstände werden dadurch undeutlicher und erhalten eine blaue Tönung. Je grösser die Entfernung wird, umso stärker wirkt diese s. g. Luftperspektive auf die Deutlichkeit und Farbengebung des Gegenstandes ein. Bei hellem Sonnenlicht lässt sich die Blautönung und kaum wahrnehmbare Undurchsichtigkeit der Luft schon in einem Abstand von nur 100 m feststellen.[1]) Für die Nahumgebung sind also beim Tageslicht die Eigenfarben, für die Fernumgebung eine Farbenschattierung in Blau charakteristisch.

Mehrere schwer wiegende Gründe sprechen somit für eine Grenze oder richtiger eine Grenzzone zwischen den beiden Hauptteilen des Gesichtsfeldes in einer Entfernung von ungef. 20—100 m Entfernung vom Beschauer. Auf der inneren, uns am nächsten liegenden Seite dieser Grenzzone haben wir also die Nahumgebung, die aus einem Teil des Gesichtsfeldes sowie dem Medium und dem Substrat besteht. Diese Nahumgebung erfassen wir mit allen unseren Sinnen, in ihr befinden wir uns ständig, wir erfassen sie auch in der Dunkelheit mit dem Gehör, dem Geruch und Getast. Nur Nahumgebung haben wir um uns in unseren Wohnhäusern, in der Nahumgebung verkehren wir mit unseren Mitmenschen.

Ausserhalb der Grenzzone breitet sich die Fernumgebung aus, ein unvergleichlich grösseres Gebiet, bläuliche Höhen und Gewässer, Wälder, Anbauflächen, Höfe und vieles andere. Alles dies sehen wir kulissenartig um uns, ohne dass wir uns direkt und klar eine Vorstellung von den Abständen in diesem Komplex bilden können. Aus dem unendlichen Himmelsraum leuchten die Sonne, der Mond und die Sterne in diese unsere sichtbare irdische Umwelt, ohne dass der primitive Mensch eine Ahnung davon hat, wie weit diese Lichtquellen entfernt sind. Diese Fernumgebung erfassen wir also nur mit dem Gesichtssinn, und wir folgen nur dem gewöhnlichen Sprachgebrauch, wenn wir sie Landschaft nennen, denn die Landschaft sehen wir, die Landschaft befindet sich nicht in unseren Zimmern, sie ist draussen, wo wir den Himmel und den Horizont sehen; um die Landschaft erfassen zu können ist ein gewisser Minimalabstand und eine gewisse Minimalbeleuchtung erforderlich.

Das oben Gesagte betrifft vorzugsweise die Raumeigenschaften des geographischen Milieus, ihre topologischen Züge. Die Geographie ist ja, wie schon oben erwähnt wurde, seit altersher Raumwissenschaft genannt worden und es gibt viele bekannte Geographen, die der Ansicht sind, dass die

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[1]) A. Heim, Luft-Farben. Zürich 1912. S. 34.

Geographie sich in erster Linie mit dem Raume und der Ausbreitung im Raume zu befassen habe.

Ohne die ausserordentliche Bedeutung der topologischen Geographie verringern zu wollen, müssen wir doch betonen, dass unsere Wissenschaft auch die Eigenschaften des Forschungsgegenstandes in der Zeit, seine chronologischen Züge nicht vernachlässigen darf. Die Geographie ist, wenn auch in weniger hervortretendem Grade, auch eine chronologische Disziplin. Mag auch die Grenze zwischen Zeit und Raum unbestimmt und fliessend sein, wir sind alle überzeugt, dass wir in der Umwelt nicht nur Unveränderlichkeit und Unbeweglichkeit haben, sondern auch Veränderlichkeit und Bewegung. Nehmen wir als Zeitmass das Jahr und untersuchen wir die chronologischen Züge in dieser Zeiteinheit, so werden wir überall auf der Erde den Rhythmus zwischen Tag und Nacht, zwischen Winter und Sommer, diese Wogenbewegung in der Zeit, diese Atemzüge des geographischen Komplexes, die wir so gut kennen, wiederfinden.[1]) Und es wird leicht sein in jeder Umgebung die vier chronologischen Hauptteile zu unterscheiden: das Perenne oder das Unveränderliche und das Transitorische oder das Veränderliche, sowie das Stabile oder das Unbewegliche und das Labile oder das Bewegliche.

Die chronologischen Züge, die wir in dem Milieu feststellen, führen uns ungesucht zu dem Kräftespiel, der Wechselbeziehung und den vielen Prozessen und Bildungen, die das geographische Milieu als eine physiologische Einheit, eine Art Mechanismus oder Organismus charakterisieren. In unserer Umgebung sind mancherlei Kräfte und Agentien mit verschiedenen Eigenschaften tätig, und ihre Wirksamkeit richtet sich auf eine Menge verschiedener Gegenstände. Das Resultat der Arbeit hängt von der Art der Wirksamkeit der Agentien und der Beschaffenheit des Gegenstandes ab: wir beobachten im Raume mancherlei Bildungen und in der Zeit verschiedenartige Prozesse. Alles das ist jedoch bekannt. Die Vertreter der wissenschaftlichen Geographie haben lange und erfolgreich Forschungen auf diesem Gebiete betrieben. Wir wollen in diesem Zusammenhang nur hervorheben, dass es die physiologische Geographie ist, die diese Fragen beantwortet, und dass die physiologisch-geographische Forschung eine eingehende Kenntnis der Struktur und der Zusammensetzung des Milieus voraussetzt.

Da wir uns einmal auf dem physiologisch-geographischen Arbeitsgebiet befinden, stellen wir gewisse dominierende Züge auch bei dem physiologischen

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[1]) VOLZ spricht vom Rhythmus in der Geographie im anderen Sinne. (W. VOLZ, Der Rhythmus in der Geographie. Mitt. d. Vereins d. Geographen zu Leipzig, 1923.)

Komplexe, gewisse bestimmende Agentien und kräftig sich geltend machende Prozesse fest. Wenn unser Beobachtungsmaterial längere Perioden umfasst, können wir, wie DAVIS und seine Schule, Erosionszyklen, oder richtiger Wirksamkeitszyklen, feststellen, die durch gewisse Agentien und Prozesse charakterisiert werden. Überall in der Landschaft sehen wir Formen, die nicht während des heutigen Zyklus haben entstehen können. Wir nennen sie disharmonisch, sie sind Überreste vergangener Zeiten mit anderen bestimmenden Agentien. Vergleichende physiologische Untersuchungen in verschiedenen Teilen der Welt lehren uns solche fremden Bildungen zu deuten. Auf diesem Wege physiologisch-geographischer Schulung wird es uns schliesslich möglich, erfolgreich die letzte grosse Frage im Arbeitsprogramm der Geographie, die Genesis des Milieus, zu behandeln.

Will man unterscheiden zwischen einer beschreibenden oder deskriptiven und einer erklärenden oder explikativen Geographie — ein Verfahren, das von manchen, und sicher mit gutem Grund, als weniger richtig angesehen wird, weil jede Erklärung schliesslich doch Beschreibung ist — so würde die Topologie und Chronologie, mit deren Hilfe wir unseren Gegenstand definieren und die geographischen Komplexe feststellen, vorzugsweise deskriptiver Natur sein, wogegen die Physiologie und der genetische Probleme behandelnde Teil der Geographie als mehr explikativ sich ansehen liessen.

Betrachten wir unsere Forschungsarbeit von einer anderen Seite, indem wir unsere Aufmerksamkeit auf die Hauptbestandteile der Umgebung im Raume richten, erhalten wir als Bestandteile in einer allgemeinen Geographie die Lehre von der Nahumgebung oder die Engyologie (griech. engys = nahe), sowie die Landschaftslehre oder Periopologie (griech. periope = Gesichtsfeld).

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Wir haben im vorhergehenden das geographische Milieu rein anthropozentrisch aufgefasst. Es ist an den Menschen gebunden. Wenn wir uns auf einem Spaziergang oder auf einer Reise von Ort zu Ort bewegen, verändert sich unsere Umgebung. Ihre Grenzen verschieben sich, je nachdem wir uns bewegen.

Es ist jedoch selbstverständlich, dass wir in unserer geographischen Arbeit uns nicht mit diesen anthropozentrischen Ganzheiten oder der Typologie der Umgebungen begnügen können, welche die Geographie vielleicht aufstellen kann. Wir müssen, wenn ich mich so ausdrücken darf, an der Erdoberfläche fixierte, erdgebundene Ganzheiten haben, die natürlichen Länder oder geographischen Individuen, von denen ich in der Einleitung sprach.

Welchen Weg haben wir nun einzuschlagen um vom Anthropozentrischen zum Erdgebundenen, von der Welt der Typen zur reellen Wirklichkeit zu kommen? Wir finden ganz sicher — um ein Beispiel zu wählen — in Finnland nicht nur eine Menge anthropozentrischer Milieus, sondern auch gewisse leicht zu definierende Landschaftstypen vertreten, wie zum Beispiel die Binnenseelandschaft und die Schärenhoflandschaft. Wie lassen sich die geographischen Individuen Finnlands bestimmen? Besitzen wir dafür eine rationale Methode, oder sind wir gezwungen unsere Gebietseinteilung mehr oder minder instinktiv vorzunehmen? Gibt es geographische Individuen von mehreren Grössenkategorien, oder sind die Dimensionen des Individuums im voraus gegeben?

Wir haben bereits die grosse Bedeutung der Landschaft bei der Charakterisierung grösserer Gebiete hervorgehoben. Stellen wir die wichtigsten perennen morphologischen Landschaftszüge zur Behandlung, nämlich die Formen der Erdoberfläche, des Wassers, der Vegetation und des s. g. umgeformten Stoffes (also der Gebäude, des Wegenetzes u. s. w.) und stellen wir auf verschiedenen Karten die Verbreitungsgebiete dieser verschiedenen Formen dar, so erhalten wir mit Hilfe dieser Karten auf synthetischem Wege leicht die Gebiete, in denen die Formen der Erdoberfläche, des Wassers, der Vegetation und des umgeformten Soffes, also die ganze Welt der in der Landschaft vorkommenden Formen, einheitlich auftritt.[1]) Im Bedarfsfalle beziehen wir auch die Farben in die Synthese ein, nachdem wir auf verschiedenen Karten auch ihre Ausbreitungsverhältnisse dargestellt haben.

Dieser kartographisch-synthetische Weg wurde zuerst von PASSARGE[2]) eingeschlagen. Sein Verfahren unterscheidet sich aber in zwei methodisch wichtigen Punkten von dem oben vorgeschlagenen. Erstens darin, dass er die durch die Tätigkeit des Menschen hervorgerufenen, oft doch sehr wichtigen Züge in der Landschaft nicht berücksichtigt, und zweitens darin, dass Charakterzüge in die Synthese einbezogen werden, die nicht direkt als Bestandteile im Gesichtsfeld enthalten sind.

Die in bezug auf ihre Landschaftszüge, also periopologisch einheitlichen Gebiete, die geographischen Komplexe oder Ganzheiten sind ohne Zweifel, um mit RITTER zu sprechen, geographische Individuen oder natürliche Länder. Oft wird heutzutage der Ausdruck natürliche Landschaften ungefähr in derselben Bedeutung verwandt. Zur Vermeidung von Missverständnissen nen-

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[1]) J. G. GRANÖ, Die landschaftlichen Einheiten Estlands.

[2]) S. PASSARGE, Die natürlichen Landschaften Afrikas. Pet. Mitt., 1908.

nen wir sie jedoch lieber geographische Provinzen oder geographische Regionen (»Landstriche»). Diese Individuen hat die spezielle Geographie zu behandeln.

Absolute Einheiten oder ein für allemal festgelegte Individuen haben wir in der Geographie nicht. Die geographische Forschung bildet die Ganzheiten, deren sie bedarf. Wenn eine Wissenschaft, so gehört die Geographie zu denen, die NEEFF[1]) Ganzheiten bildend genannt hat, eine Gruppe, zu der u. a. die Pflanzen- und Tierökologie sowie die Soziologie gehören.

Eine geographische Provinz order Region hat demnach unserer Meinung nach zwei Bedingungen zu erfüllen. Sie muss in periopologischer Beziehung ein einheitlicher Komplex und sie muss solche Eigenschaften besitzen, dass sie als Individuum wissenschaftlichen Wert haben kann. Nur Einheiten von einer gewissen Minimalgrösse können unser Interesse beanspruchen. Bleibt der Umfang unter diesem Minimalareal, so beachten wir das Gebiet fast nur so wie der Botaniker das einzelne pflanzliche Individuum, d. h. nur in dem Masse, wie das in Frage stehende Gebiet von allgemein geographischem Gesichtspunkt Wertvolles aufzuweisen hat.

Theoretisch liessen sich genügend umfangreiche geographische Individuen denken, die in bezug auf die Landschaft und die Nahumgebung, ja auch in Hinsicht auf die soziale Umwelt einheitlich wären. Dieses Ziel, so stellen wir uns vor, liesse sich durch Auslassung weniger wesentlicher Züge und eine immer grössere Generalisierung erreichen. Man wäre dann zwar gezwungen die unserer Meinung nach grosse Bedeutung der Landschaftszüge bei der Bestimmung grösserer geographischer Individuen weniger stark hervorzuheben, vielleicht sogar unberücksichtigt zu lassen.

In der Praxis kommt man jedoch bald zu der Einsicht, dass weder die Auslassung von vermeintlichen Kleinigkeiten noch die Generalisierung allzu weit getrieben werden kann, ohne dass das Komplexe, das Mannigfaltige, also gerade das, was für jede geographische Ganzheit charakteristisch ist, aufs Spiel gesetzt wird. Wir bestreiten keineswegs, dass sich gewisse Einheiten demnach auf synthetischem Wege erreichen lassen — ein methodisch wertvoller Versuch in dieser Richtung ist von A. SCHULTZ[2]) gemacht worden —, glauben aber, dass diese Individuen dann leicht zu verzerrt erscheinen können um wirklichkeitsgetreu zu wirken.

Je kleiner ein Gebiet ist, umso geringere Schwankungen weisen seine einzelnen charakteristischen Züge auf und umso mehr geographische Eigenschaften können innerhalb der Grenzen dieses Gebietes einheitlich auftreten, ohne dass man eine allzu starke Generalisierung vorzunehmen braucht. Oder — um diese Frage mehr praktisch anzugreifen — je mehr charakteristische Züge wir bei der Bestimmung der regionalen Einheiten berücksichtigen und je weniger wir generalisieren, umso geringer an Umfang werden die Individuen, die durch die Synthese auskristallisiert werden. So sind z. B. in Finnland die Gebiete, die nach ihren engyologischen Eigenschaften, also ihrer Nahumgebung, d. h. ihrem Gesichtsfeld, ihrem Medium und ihrem Substrat nach einheitlich sind, — wir wollen sie mangels eines besseren Ausdruckes geographische Kleingebiete nennen — meistens nur einige Tausend Quadratmeter gross. Natürlich können diese kleinen Einheiten als Individuen keinen Anspruch auf wissenschaftliches Interesse machen, doch muss man untersuchen, welche Kleingebietstypen in den bedeutend umfangreicheren, periopologisch bestimmten geographischen Provinzen order Regionen vertreten sind, denen wir unsere Aufmerksamkeit schenken. Es wäre nicht nur eine vergebliche Mühe, sondern auch geradezu praktisch unmöglich bis ins einzelnste alle diese unzähligen, engyologisch einheitlichen »Zellen» in den grösseren geographischen Individuen zu untersuchen.

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[1]) F. NEEFF, Der Geist der Wissenschaft. Karlsruhe 1925.

[2]) A. SCHULTZ, Die natürlichen Landschaften von Russisch-Turkestan. Hamb. Univers. Abh. aus d. Geb. d. Auslandskunde, 2, 1920.

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Wir fassen zusammen:

1) Die Geographie ist eine Wissenschaft mit eigenen Forschungsobjekten. Gegenstände geographischer Forschung sind

   a) das geographische Milieu sowie
   b) die geographischen Individuen.

2) Das geographische Milieu ist die anthropozentrische Umwelt, die der Mensch mit seinen Sinnen erfasst.

Qualitativ unterscheiden wir in ihr

   a) das Gesichtsfeld oder den sichtbaren Komplex,
   b) das Medium, oder den Komplex, dessen Auffassung vom Gehör, Geruchs- und Tastsinn durch die Luft vermittelt wird, sowie
   c) das Substrat oder die Unterlage, deren Eigenschaften durch den Tastsinn bestimmt werden.

Quantitativ, in bezug auf die Eigenschaften des Gesichtsfeldes im Raum, wird das geographische Milieu eingeteilt in

   a) die Nahumgebung, deren äussere Grenze 20—100 m vom Beschauer entfernt liegt und die der Mensch mit allen seinen Sinnen auffasst, sowie

b) die Fernumgebung oder Landschaft, die sich von dieser Grenzzone bis zum Horizont erstreckt, und die der Mensch nur mit dem Gesichtssinn erfasst.

3) Geographische Individuen nennen wir die erdgebundenen, von der Geographie gebildeten Ganzheiten, die ihren geographischen Eigenschaften nach, also in bezug auf die sinnlich wahrnehmbaren Züge der Umgebung, in mehr oder minder grossem Umfang als Komplexe einheitlich sind.

4) Geographische Ganzheiten von der Grösse, dass sie als Individuen wissenschaftliche Bedeutung haben könnten, erhalten wir durch rationelle Analyse und nachfolgende Synthese der bestimmenden Züge in der Landschaft. Diese Ganzheiten bezeichnen wir als geographische Provinzen oder Regionen.

5) Die geographischen Provinzen oder Regionen weisen eine grössere oder kleinere Anzahl von »Kleingebieten» auf, die in bezug auf die Nahumgebung einheitlich sind. Diese beanspruchen jedoch nicht als Individuen sondern als Typen die Aufmerksamkeit der Geographie.

ACTA GEOGRAPHICA 1, N:o 3

ZUR FRAGE
VON DER
OSTBALTISCHEN RASSE

VON

KAARLO HILDÉN

HELSINKI 1927

HELSINGFORS
1927
DRUCK VON A.-B. F. TILGMANN

VORWORT.

Die vorliegende Studie besteht hauptsächlich aus einem Vortrag, den der Verfasser auf der internationalen Anthropologenversammlung in Amsterdam im September 1927 gehalten hat. Weil aber die Dauer der Vorträge in der Versammlung auf je 20 Minuten begrenzt worden war und weil deshalb nur einige Hauptpunkte berührt werden konnten, hat der Verfasser den Vortrag späterhin mit verschiedenen Zusätzen veröffentlicht.

Helsingfors, im Oktober 1927.

Der Verfasser.

Betrachtet man die sog. Rassenkarten, die oft in den geographischen Kartenwerken enthalten sind, so macht man die Beobachtung, dass Finnland auf der grossen Mehrzahl derselben als das Verbreitungsgebiet der »mongolischen» oder »gelben» Rasse bezeichnet wird und folglich dieselbe Farbe hat, wie der grösste Teil des asiatischen Festlandes. Und dieses Kartenbild wird durch die Angaben ergänzt, die in den sowohl für die Schulen als für die Hochschulen herausgegeben Lehrbüchern zu finden sind.

Lassen wir indessen diese Arbeiten bei Seite, denen in bezug auf Rassenfragen keine wissenschaftliche Bedeutung zuzuschreiben ist, und halten uns einzig und allein an anthropologische und rassenkundliche Werke, so kann man feststellen, dass die Auffassungen von der rassischen Stellung der Finnen strittig und widersprechend sind. Teils begegnen uns Angaben derselben Art wie in den obenerwähnten geographischen Lehrbüchern, teils werden ganz andere Auffassungen angeführt. Dies beruht einerseits darauf, dass Finnland in anthropologischer Hinsicht noch nicht genügend erforscht ist — eine grössere Massenuntersuchung der Bevölkerung Finnlands ist gegenwärtig unter der Leitung Prof. Y. KAJAVAS in Angriff genommen worden —, andererseits darauf, dass die ganze Frage von der Rassenzusammensetzung der europäischen Bevölkerung noch lange nicht geklärt ist.

Der erste, der auf Grund eigener Beobachtungen an Lebenden eine Charakteristik der Rasseneigenschaften der Finnen versucht hat, ist VIRCHOW[1]), der nach einer im Jahre 1874 durch Finnland vorgenommenen Reise u. a. folgendes hervorhebt: »Das ist aber gewiss von höchster Bedeutung, dass wir jetzt wissen, dass die Finnen blond sind, dass sie also mit den als brünett ausgegebenen Brachycephalen von Deutschland, Frankreich und Italien in keinem Zusammenhang stehen. Es gibt demnach auch blonde Brachycephalen, denn die Brachycephalie sämtlicher finnischer Stämme in Finnland ist über allen Zweifel erhaben.»

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[1]) R. VIRCHOW: Vortrag über die physische Anthropologie der Finnen. Verhandlungen der Berliner Gesellschaft f. Anthrop., Ethnol. und Urgesch., Sitz. d. 17. Okt. 1874.

Diese Sätze Virchows können noch heute für gültig angesehen werden. Man muss zwar hinzufügen, dass Finnlands finnische Bevölkerung[1]), um die es sich hier allein handelt, selbstverständlich nicht durchgehend zu den »blonden Brachycephalen» geführt werden kann — hier, wie überall in unserem Weltteil, ist die Rassenmischung stark gewesen und hat zu verschiedenen Neukombinationen Anlass gegeben —, jedenfalls kann man aber behaupten, dass gerade dieser Typus der vorherrschende im Lande ist. Davon zeugen die hier vorgenommenen anthropologischen Untersuchungen[2]), und auch direkte Beobachtungen lassen es bereits erkennen.

Als Charakteristik eines Menschentypus sind die beiden obenerwähnten, an und für sich wichtigen anthropologischen Merkmale — helle Komplexion und Brachycephalie — indessen nicht genügend. Wie ist dieser in Finnland so zahlreich vorkommende blonde brachycephale Typus im übrigen zu charakterisieren?

Der schwedische Anthropologe G. Retzius, der während seiner Reisen in Finnland im Sommer 1873 sowohl lebende Individuen als Schädelmaterial untersuchte, gibt einige Jahre später (zusammen mit C. Lovén und E. Nordenson) folgende Charakteristik[3]) des betreffenden Typus, den er den »tavastländschen» (nach der Landschaft Tavastland, finn. Häme) nennt: »Körper stark, fest, breitschulterig, im allgemeinen ziemlich breit, untersetzt, kräftige Gliedmassen, von mittlerer Grösse; doch findet man sowohl kurze als auch auffallend lange Individuen. Die Haut elastisch, weder zu Fettleibigkeit noch Magerkeit neigend. Die Hautfarbe ziemlich hell. Der Kopf gewöhnlich gross, kurz und breit (brachycephal), nicht aber eigentlich hoch, oft etwas eckig, Tubera parietalia entwickelt. Das Gesicht gross, lang, vor allem aber auffallend breit sowohl in der Gegend der Stirn, als in der Gegend der Backenknochen und des Kinnes; der Unterkiefer stark entwickelt, mit grossen, weit voneinander abstehenden Ecken. Die Nase klein, ziemlich breit, entweder stumpf oder hoch, häufiger mit einer kleinen, meist etwas nach oben gebogenen Spitze. Auch der Mund ist ziemlich breit. Die Lidspalte ziemlich eng, manchmal schräg nach innen gerichtet. Iris hell, graublau oder häufiger blaugrau bis grau. Die Augenbrauen schwach entwickelt, hell. Gesichtsausdruck mürrisch, nicht sympathisch. Das Haar auf dem Scheitel hell, oft flachsfarbig, sonst hell cendré, schlicht, nie lockig, recht weich. Bei Kindern ist es so gut wie immer flachsfarbig, bisweilen fast gelblich weiss, bei älteren dunkelt es oft etwas nach, so dass es cendré wird; nicht selten behält es aber dunklere Flachsfarbe. Der Bartwuchs ist gewöhnlich schwach, die Barthaare stehen undicht, sind kurz und streif, hell, manchmal rötlich.»

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[1]) Es gibt auch eine schwedisch sprechende Bevölkerung im Lande (etwa 11 % der Einwohnerzahl), deren Siedlungsgebiet die Skären Åland-Åbo und die Küstengegenden am Finnischen und Bottnischen Meerbusen umfasst.

[2]) Vrgl. folgende Arbeiten:

Chr. Lovén, E. Nordenson u. G. Retzius: Till kännedom om de finska folkstammarnes raskaraktärer. Tidskrift för antropologi och kulturhistoria, Bd. 1: 2, Stockholm 1876.

G. Retzius: Finska kranier jämte några natur- och litteraturstudier inom andra områden af finsk antropologi. Stockholm 1878.

F. W. Westerlund: Studier i Finlands antropologi I—VI. Fennia 18, 20, 21, 32 u. 33. Helsingfors 1900, 1902, 1904, 1912, 1913.

K. Hildén: Die anthropologische Erforschung Finnlands. Arch. f. Anthrop. N. F. Bd. XIX, 1921.

Y. Kajava.: Die anthropologische Untersuchung des finnischen Volkes. Anthrop. Anzeiger. Jahrg. II, 1925.

[3]) Lovén-Nordenson-Retzius: 1876, l. c., S. 14—15 und Retzius: 1878, l. c. S. 161.

In einer neulich herausgegebenen Arbeit gibt der Sprach- und Rassenforscher NORDENSTRENG[1]), in Finnland geboren und aufgewachsen, späterhin aber nach Schweden übergesiedelt, eine etwas eingehendere Beschreibung, die sich teils auf literarische Angaben, teils auf persönliche Beobachtungen stützt. Er geht davon aus, dass es sich hier um eine »selbständige» Rasse handelt, der »ostbaltischen Rasse», die nicht allein in Finnland, sondern in einem viel grösseren Gebiet, vornehmlich in den Ländern östlich von der Ostsee verbreitet ist, und charakterisiert dieselbe auf folgende Weise (S. 116—118): »Die ostbaltische Rasse hat zwar eine entschieden helle Hautfarbe aber ohne die durchsichtige zarte, rosige Klarheit, die ein nordisches Merkmal ist. Vielmehr hat die ostbaltische Hautfarbe einen etwas schmutzigen, schwach graugelben Ton. Ihr Haar ist streif, borstig, graublond in verschiedenen Tönen, bis zu flachsweiss. Eine etwas rötliche Goldblondheit dürfte der ostbaltischen Rasse kaum eigen sein, sondern, wo eine solche vorhanden ist, muss sie wohl ihrem Ursprung nach als nordisch betrachtet werden. Der Bart ist wie das Haupthaar grob und hell, dazu undicht. Die Farbe der Augen ist blau oder recht oft grau, in beiden Fällen aber sehr hell, wässerig und zugleich gleichsam weniger durchsichtig. Die ostbaltische Rasse hat einen sehr kräftigen Körperbau, von mittlerer Grösse oder vielleicht etwas darüber hinaus, mit besonders breiten Schultern und breiter Brust, aber verhältnismässig kurzen Beinen und knieendem aber kräftigem Gang. Das Gesicht ist breit und knochig. Die Stirn ist hoch aufgerichtet, etwas steiler als bei der nordischen Rasse, nicht aber so steil wie bei der Alpinen. Sie ist sehr breit, besonders der oberste Teil, und sowohl die Augenbrauenbogen als auch die Stirnhöcker treten merkbar hervor. Die Backenknochen stehen kräftiger hervor als bei irgend einer anderen Rasse in Europa, ausser der lappländischen, und dies im Verein mit den groben, breiten Unterkiefern gibt dem Gesicht eine auffallende Breite, obwohl es zugleich recht lang ist. Die Augen liegen nicht so tief wie bei der nordischen Rasse, sondern etwas flacher eingebettet, jedoch ohne den Eindruck von »Fischaugen» zu machen. Die Lidspalte selbst ist oft recht schmal und hat vielleicht bisweilen einen schwachen Zug schräg aufwärts, häufiger aber im Gegenteil schräg abwärts. Die Nase ist an der Wurzel eingedrückt und hebt sich wenig vom Gesicht ab bis auf die recht breite Spitze, die häufig etwas nach oben gedrückt vorkommt. Das ostbaltische Kinn ist anscheinend meist recht schwach entwickelt, und besonders rassentypisch ist der sehr scharfe Winkel des Unterkiefers. Der ostbaltische Kopf erscheint gewöhnlich gross, mit grossem, etwas eckigem Gesicht, und sitzt einem kurzen Hals auf. Die ganze ostbaltische Figur ist gedrungen und untersetzt. Nichtsdestoweniger sind diese Körper — im Gegensatz zu dem, was für die alpine Rasse angegeben wird — sehr beweglich, nicht zum mindesten in bezug auf das Verhältnis der Gliedmassen zum Rumpf. Es ist eine Rasse von kräftigen, zähen Ackerbauern, ausdauernden Waldwanderern und Ruderern, schnellen, unermüdlichen Skiläufern und sonstigen Sportsleuten.»

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[1]) ROLF NORDENSTRENG: Europas människoraser och folkslag. 3. Aufl. Stockholm 1926.

Zu diesen Charakteristiken ist hinzuzufügen, dass die Brachycephalie keineswegs extrem, sondern vielmehr recht schwach ist. Auf Grund der in Finnland vorgenommenen Messungen dürfte der Kephalindex durchschnittlich auf z:a 80—83 geschätzt werden können. Die Körpergrösse ist, wie auch NORDENSTRENG hervorhebt, recht erheblich und dürfte betreffende genuine Finnen durchschnittlich z:a 168—169 cm ausmachen. Schliesslich möchte ich in diesem Zusammenhag zwei negative Eigenschaften als Beitrag zur Charakteristik hervorheben. Die sog. Mongolenfalte, die in den medianen Augenwinkeln vorkommende und die Karunkeln oft ganz und gar deckende Hautduplikatur, wird nur in seltenen Ausnahmefällen angetroffen. Auch fehlt der vom Corium-Pigment verursachte blaue Sacral- oder Mongolenfleck, der so kennzeichnend für die Mongoliden ist.

Man kann sich leicht davon überzeugen, dass die Charakteristik, die NORDENSTRENG, mit besonderer Berücksichtigung der Finnen, von der ostbaltischen Rasse gibt, mit den Charakteristiken übereinstimmt, die DENIKER[1]) von der »race orientale», SERGI[1]) vom »Homo arcticus fennicus», PÖCH[2]) und KRAITSCHEK[3]) von der »Ostrasse» geben. Und diese Übereinstimmung wird auch ausdrücklich von NORDENSTRENG betont. Es handelt sich also hier eigentlich lediglich um Namen, nicht um Tatsachen. Die NORDENSTRENGsche Charakteristik ist jedoch vollständiger und erschöpfender als die übrigen. DENIKER z. B. schreibt bloss (3 Aufl. S. 490): »Charactères principaux: taille peu élevée (1 m 63 ou 1 m 64 en moyenne), tête modérément arrondie (ind. ceph. 82 a 83 sur le vivant), cheveux droits, d'un blond cendré ou de filasse; face carrée, nez souvent retroussé, yeux bleus ou gris». Die Körpergrösse wird, wie ersichtlich, als verhältningsmässig niedrig angegeben, dies ist aber von geringerem Belang, da die peristatischen Faktoren ja gerade hinsichtlich dieser Merkmale grosse phänotypische Veränderungen verursachen. (Ich möchte des Vergleichs wegen mitteilen, dass die Durchschnittsgrösse der Wehrpflichtigen mit finnischer Muttersprache in Finnland nach den von WESTERLUND in den Jahren 1885 — 92 vorgenommenen Messungen 166.8 cm betrug und dass die mittlere Körpergrösse der Soldaten bei ihrer Entlassung nach den Messungen KAJAVAS 1921—22 170.3 cm ausmachte — eine Steigerung, die den verbesserten hygienischen und alimentären Verhältnissen dürfte zuzuschreiben sein).

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[1]) J. DENIKER: Les races et les peuples de la terre. Paris 1900, 3. ed. Paris 1926.

Das Verbereitungsgebiet der »orientalischen (östlichen) Rasse» wird von DENIKER auf folgende Weise beschrieben: »Les représentants de cette race sont les Blancs-Russiens, les Poliechtchouki des marais de Pinsk, certains Lithuaniens. A l'état de mélange, ce type est fréquent parmi les Veliko-Rousses ou Grands-Russiens du nord et du centre de la Russie, ainsi qu'en Finlande et en Prusse orientale». Es umfasst somit nach DENIKER ein kolossales Gebiet in Osteuropa, und Finnland macht nur einen geringen Ausläufer desselben aus.

Es liegen bereits eine ganze Menge eingehender Einzeluntersuchungen vor, welche an die Hand geben, dass das von DENIKER skizzierte Verbreitungsgebiet mit den tatsächlichen Verhältnissen übereinstimmt. Wir können aber hinzufügen, dass das Gebiet noch ausgedehnter ist, als DENIKER angibt. Man erlaube mir dies durch einige Auslesen aus der zu Gebote stehenden Literatur zu beweisen zu versuchen.

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[1]) G. SERGI: L'Uomo. Torino 1911.

[2]) R. PÖCH: III. Bericht über die von der Wiener Anthropologischen Gesellschaft in den k. u. k. Kriegsgefangenenlagern veranlassten Studien. Mitt. d. Anthrop. Ges. in Wien, Bd. XXXXVII, 1917.

[3]) G. KRAITSCHEK: Rassenkunde mit besonderer Berücksichtigung des deutschen Volkes. Wien 1924.

In ganz Russland scheint die »ostbaltische Rasse» sehr stark vertreten zu sein. Davon zeugen mehrere Abhandlungen Tschepourkowskys1)), der unter sowohl Männern als Frauen in Grossrussland einen brachycephalen, hellhaarigen Typus mit blauen oder grauen Augen und von relativ hoher Statur, den er den »Waldaischen Typus» nennt, festgestellt hat. Davon zeugen auch die kritischen Untersuchungen, die Anutschins verdienstvoller Nachfolger an der Moskauer Universität V. V. Bunak2)) sowohl unter der slawischen Bevölkerung Russlands als auch unter den dort lebenden finnischen Stämmen durchgeführt hat. Den hier allgemein nachweisbaren blonden, zeimlich hochgewachsenen, brachycephalen (mittl. Index z:a 82), mesorrhinen Typus, dem (Tscheremissen-Abh., S. 160) »die mongoloiden Sonderzüge fehlen», nennt Bunak den baltischen Typus, type baltique; er ist, wie der Verfasser hervorhebt, mit Denikers »race orientale» und Tschepourkowskys »Waldaischen Typus» identisch. Und dieser Typus kommt, seiner Ansicht nach, ausser bei den Slawen und Finnen auch bei Letten, Littauern u. a. innerhalb der Grenzen Russlands lebenden Völkern vor. Auch eine kurze Abhandlung von Jarcho3)), der eine Menge Grossrussen in Gouvernement Wladimir untersucht hat, mag hier erwähnt werden.

Ein ähnlicher Typus wird aus Wolhynien in einer verdienstvollen Abhandlung von Hella Pöch4)) beschrieben, die denselben die »helle Ostrasse» nennt. Sie hebt die Sonderstellung dieser Rasse scharf hervor, die (S. 34) »zu Unrecht von einem grossen Teile der Anthropologen noch nicht anerkannt ist, wiewohl ihre Merkmale weit über Osteuropa hinaus, bis nach Mittel- und

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1)) E. M. Tschepourkowsky: Zur Anthropologie der russischen Frauen (russisch in Русскій антропологическій журналъ IV, 1903, Referat in Arch. f. Anthrop. N. F. IV, 1906).

E. M. Tschepourkowsky: Zwei Haupttypen der Grossrussen. Korr.-Bl. d. Ges. f. Anthrop. Bd. XLI, 1910.

E. M. Tschepourkowsky: Anthropologische Studien. Arch. f. Anthrop. N. F. Bd. X, 1911.

2)) В. В. Бунак: Антропологический тип черемис. (Resumé: Le type anthropologique des Tchérémisses). Русск. антропол. журн. XIII, 1924.

В. В. Бунак: Антропологический тип мордвы (Resumé: Le type anthropologique de la Mordva). Русск. антропол. журн. XIII, 1924.

V. V. Bunak: Le mouvement anthropologique en Russie depuis 1924. Rev. anthrop. 1926.

3)) А. И. Ярхо: Наблюденія над антропологическим типом великороссов Владимирской губернии (Resumé: Quelques données sur l'anthropologie de la partie centrale R. S. F. S. R.). Русск. антропол. журн. XV, 1926.

4)) Hella Pöch: Beiträge zur Anthropologie der ukrainschen Wolhynier. Mitt. d. Anthrop. Ges. in Wien, Bd. LV und LVI, Wien 1926.

Süddeutschland verbreitet sind, vom skandinavischen Norden ganz zu schweigen» und dessen »Schädelform bis in das jüngere Paläolithikum hinein zu verfolgen ist». Merkwürdigerweise bezeichnet HELLA PÖCH diese helle Ostrasse als (S. 35) »ausgesprochen mongolid.»

Der Typus ist auch aus Polen gut bekannt, über dessen anthropologische Verhältnisse CZEKANOWSKI wertvolle Abhandlungen veröffentlicht hat. Durch Prüfung von Korrelationstabellen und Variationspolygonen hat er[1]) in der Bevölkerung Polens einen Typus nachgewiesen, der — wie er selbst (S. 189) hervorhebt — mit DENIKERS »race orientale» übereinstimmt. Er nennt ihn den »präslawischen oder β-Typus», und dieser Typus ist der vorherrschende in der Landbevölkerung im vormaligen Russisch-Polen, wie auch in Weissrussland. In einer späteren Abhandlung[2]) hat CZEKANOWSKI bei der Untersuchung von Schädelmaterial mit Hilfe der Methode der Differentialdiagnose konstatiert, dass der »präslawische Typus d. h. die Ost-Rasse von DENIKER» schon in der neolitischen Periode ein grosses Verbreitungsgebiet in Europa hatte. Von den Ergebnissen dieser Untersuchung mag noch folgendes erwähnt werden (S. 13): »Der osteuropäische (=präslawische) Typus ist wohl als ein Relikt der neolitischen Periode aufzufassen. In West-Europa sehen wir ihn in den tiefen prähistorischen Schichten, in Polen ist er bereits in die tieferen sozialen Schichten hinuntergedrückt, und im europäischen Osten, wo sich die primitiveren Verhältnisse noch besser erhalten haben, tritt er in den Vordergrund». Mehrere Schüler CZEKANOWSKIS haben zu der Erforschung der Anthropologie Polens mit wichtigen Arbeiten beigetragen. Ich erwähne hier insbesondere STOLYHWO, der u. a. eine eingehende Analyse der anthropologischen Typen veröffentlicht hat[3]). Hier tritt uns wieder der blonde kurzköpfige und breitgesichtige Typus entgegen, für welchen er den Namen »Homo fanotrichus glaucops brachycephalus» oder kürzer »H. fanobrachycephalus» vorschlägt. Er betrachtet denselben als eine der drei fundamentalen Typen Europas — die beiden übrigen sind H. nordicus (»H. fanodolichocephalus») und H. mediterraneus (»H. skotodolichocephalus») — dessen Zentrum für die Ausstrahlung im Norden Zentraleuropas liegt. Er wird in Kürze folgenderweise charakterisiert (S. 94): »Couleurs des cheveux blond, couleur des yeux bleu, taille moyenne, membre supérieur long, membre inférieur moyen, indice céphalique brachycéphale, indice facial chamaeprosope, indice nasal leptorhine, forme du nez droit ou concave». Von dem Verbreitungsgebiet des Typus sagt STOLYHWO: »Puisque ce terrain était occupé par les anciens Slaves qui furent ensuite germanisés, nous pouvons donc accepter l'existence d'un certain lieu anthropologique entre la population slave primitive de l'Allemagne septentrionale d'aujourd'hui et les types blonds brachycephales qui ont été établis sur le terrain des provinces du nord de la Hollande, de la Pologne, de la Lithuanie et de la Russie occidentale».

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[1]) J. CZEKANOWSKI: Beiträge zur Anthropologie von Polen. Arch. f. Anthrop. N. F. Bd. X. 1911.

[2]) J. CZEKANOWSKI: Anthropologische Beiträge zum Problem der slawisch-finnischen Beziehungen. Suom. Muinaism.-yhd. Aikakauskirja XXXV:4, Helsinki 1926.

[3]) K. STOLYHWO: Analiza typow antropologicznych (Resumé: Analyse des types anthropologiques). Swiatowit. Tom XII, n:o 4, Warszawa 1924.

Auch bei den Tjechen ist das Vorkommen eines blonden kurzschädligen Typus von SCHIFF[1]) nachgewiesen worden, der denselben in Zusammenhang mit gleichen Bestandteilen der Bevölkerung Osteuropas stellt. Es möge gleichfalls bemerkt werden, dass SCHIFF das Vorkommen des Typus schon während der jüngeren Steinzeit nachweist.

Es ist sehr wahrscheinlich, dass die »ostbaltische Rasse» auch in den baltischen Staaten zahlreich vertreten ist, wiewohl, meines Wissens, eigentliche Rassenanalysen aus diesen Ländern nicht vorliegen. Aus Lettland hat BACKMAN zwar eine Reihe verdienstvoller Studien[2]) veröffentlicht, aus denen hervorgeht, dass die für die ostbaltische Rasse charakteristischen Merkmale daselbst zahlreich vorkommen, er hat aber noch keine zusammenfassende Untersuchung über die bei den Letten vertretenen Rassentypen herausgegeben. Dasselbe gilt von Estland, unter dessen Bevölkerung das ostbaltische Element sicherlich vorherrschend ist. Ganz neulich hat WILLEMS eine Dissertation[3]) über die Anthropologie der Esten veröffentlicht, da diese aber vorläufig nur in drei mit der Schreibmaschine geschriebenen Exemplaren vorliegt, hat mir nur ein von KAJAVA verfasstes Resumé[4]) zur Verfügung gestanden, auf dessen Basis keine Schlüsse über die Verbreitung der Rasse zu ziehen sind. Selbst habe ich auf der Estland gehörenden, aber von schwedisch sprechenden Einwohnern bewohnten Insel Runö im Rigaischen Meerbusen

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[1]) F. SCHIFF: Beiträge zur Kraniologie der Czechen. Arch. f. Anthrop. N. F. XI. 1912.

[2]) G. BACKMAN: Die Körperlänge der Letten. Uppsala Läkareför. Förhandl. N. F. Bd. XXIX. Uppsala 1924.

G. BACKMAN: Haarfarbe und Haarform der Letten. Ibid. Bd. XXIX, 1924.

G. BACKMAN: Anthropologische Beiträge zur Kenntnis der Bevölkerung Lettlands. Acta Univ. Latviensis, Bd. XII. Riga 1925.

[3]) R. WILLEMS: Zur Anthropologie der Esten. Dorpat 1926.

[4]) Y. KAJAVA: Virolaisten antropologisista ominaisuuksista. Duodecim XLII: 1. Helsinki 1927.

Untersuchungen vorgenommen und die Bevölkerung nach ihrer Rassenzusammensetzung zu analysieren versucht[1]. Hierbei zeigte es sich, dass man zwei Hauptelemente sehr deutlich unterscheiden konnte, von denen das eine gerade der blonden ostbaltischen, das andere der blonden nordischen Rasse beizuzählen war. Beide kamen ungefähr ebenso zahlreich vor.

Es erhellt also aus den oben angeführten Studien, dass der Menschentypus der besonderen Art, die die »ostbaltische Rasse» zweifelsohne ausmacht, über die ganze östliche Hälfte unseres Weltteils verbreitet ist. Jedoch muss gleichzeitig hinzugefügt werden, dass er als ein bedeutendes Rassenelement auch in der Bevölkerung des Skandinavischen Nordens und auch in Zentraleuropa zu finden ist.

Besonders in Skandinavien und namentlich in Norwegen ist der Frage von den »blonden Brachycephalen» viel Interesse entgegengebracht worden. In dem letzterwähnten Lande lenkte Arbo zuerst die Aufmerksamkeit auf diesen Typus, anfangs andeutungsweise[2], später in einer klaren und durchdachten Darstellung[3]. Auch Hansen hat eine typologische Studie[4] über den betreffenden Typus herausgegeben, den er den »Jaeder Typus» nennt, nach Jaederen, wo derselbe besonders vorherrschend ist.

Es verlohnt sich die auf scharfen Beobachtungen gegründete und kritisch durchdachte Studie Arbos mit einigen Worten zu berühren. Er gibt eine ausführliche Beschreibung der physischen (und auch psychischen) Eigenschaften des Typus — eine Charakteristik, die mit den oben angeführten Charakteristiken verschiedener Autoren aus dem Gebiet östlich von der Ostsee im grossen und ganzen völlig übereinstimmt. Ungefähr auf folgende Weise beschreibt er den blonden brachycephalen Typus in Norwegen: »Der Kephalindex ist durchschnittlich z:a 83—84. Bei den Lebenden bemerkt man besonders die breite und flache Stirn mit der eigentümlich stark vorgewölbten oberen Schläfenpartie, die grossen flachen Tubera frontalia und die flache untere Mittelpartie. Das breite, kurze, etwas flache Gesicht macht im Verein mit den hervortretenden Temporalpartien und den Stirnhöckerchen sowie der grossen Backenbreite einen oft etwas viereckigen Eindruck. Die Nase ist klein, kurz und niedrig, nicht aber besonders breit, im allgemeinen mit etwas konkavem Rücken. Die Backenknochen breit, nicht aber besonders hervorstehend. Der Winkel des Unterkiefers zwischen Ramus ascendens und Corpus ist weniger stumpf als bei den Langköpfigen. Der Unterkiefer liegt deshalb gleichsam horizontaler. Das Kinn ist kurz und sich zuspitzend, die Zähne kräftig und dicht stehend. Die Haut ist im allgemeinen nicht so rötlich wie bei den Langköpfigen, sondern graulich bleicher. Das Haar ist öfters gelbblond und blond, bisweilen hell rotbräunlich, schlicht, ganz vereinzelt schwach lockig. Die Augen sind klar blau, graublau, oder schwach bläulich braun. Der Körperbau ist gut, im allgemeinen untersetzt und kräftig. Der Hals ist kurz, die Schultern breit und gerade. Die Hände kurz und breit, die Füsse ebenfalls etwas fleisschig aber gut geformt.» Dieser Typus, der besonders in den Küstengegenden von Sørlandet und Vestlandet verbreitet ist, wo er an vielen Orten die Hauptmasse der Bevölkerung ausmacht, ist nach Arbo ein ausgeprägter und sehr charakteristischer blonder Typus, von dem man unmöglich voraussetzen kann, dass er seine Blondheit von der langköpfigen nordischen Bevölkerung erhalten hätte. Er weist nach Arbo sehr grosse Ähnlichkeiten mit dem von Retzius aus Finnland beschriebenen »tavastländschen» Typus auf — deshalb nennt er den Typus »finnoid» oder »kvaenoid» — hat aber dagegen »nichts mit den Brachycephalen Süddeutschlands zu tun» und auch nichts mit dem lappländischen Typus. Ferner wird hervorgehoben, dass der Schädelbau derselbe wie der von G. Retzius[1]) aus dem Steinalter Schwedens beschriebene zu sein scheint, weshalb Arbo gewichtige Gründe haben will, die dafür sprächen, dass »die Vorfahren dieses Typus auf die ältesten Besiedler des Landes zurückzuführen seien». — In letzter Zeit hat Bryn die Frage von den blonden Brachycephalen Norwegens zur Behandlung vorgenommen[2]), hat aber eine ganz andere Auffassung von der Sache, wovon später Näheres.

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[1] K. Hildén: Die Runö-Schweden in anthropologischer Hinsicht. Fennia 47, n:o 2, Helsinki 1926.

[2] C. O. E. Arbo: Carte sur l'indice céphalique en Norvège. Revue d'Anthropologie, T. II. 1887.

C. O. E. Arbo: Udsigt över det sydvestlige Norges anthropologiske Forhold. Ymer, Tidskrift utgiven av Svenska Sällskapet för antr. o. geogr. 1894.

[3] C. O. E. Arbo: Den blonde Brachycephal og dens sandsynlige Udbredningsfelt. Christiania Vidensk.-Selskabs Forhandl. n:o 6, 1906.

Kürzer wird derselbe Gegenstand behandelt in:

C. O. E. Arbo: Zur Anthropo-Ethnologie des südwestlichen Norwegen. Arch. f. Anthrop. N. F. Bd. III, 1905.

[4] C. F. Hansen: Om Jaedertypen. Christiania Vidensk.-Selsk. Forhandl. 1900.

Beträffend Schweden geht bereits aus der von Retzuis und Fürst herausgegebenen grossen anthropologischen Monographie[3]) hervor, dass die blonden

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[1]) G. Retzius: Crania suecica antiqua. Stockholm 1899.

[2]) Von Bryns zahlreichen Abhandlungen möge nur der letzte erwähnt werden, der die blonden Brachycephalen eingehend behandelt: Die Menschenvarietäten Norwegens, Anthrop. Anzeiger, Jahrg. III, 1926.

[3]) G. Retzius und C. M. Fürst: Anthropologia Suecica, Beiträge zur Anthropologie der Schweden. Stockholm 1902.

Brachycephalen einen nicht unerheblichen Bestandteil der Bevölkerung des Landes ausmachen. Die Frage von diesem Typus wird in dem von dem Rassenbiologischen Institut in Uppsala neulich veröffentlichten grossartigen rassenkundlichen Werk[1]) einer eingehenderen Untersuchung unterworfen. Es wird dort die Auffassung ausgesprochen, dass die blonden Brachycephalen, wenigstens zum grössten Teil (S. 52) »very probably forms an independent race, which may suitably be termed the 'East Baltic'». Jedoch ist »naturally the possibility not excluded that prolonged race-mixture of dark brachycephals (e. g. Alpines) and light dolichocephals would sooner or later result in the production, according to the Mendelian laws, of dark mixed types as well as a small number of light brachycephals, but there would exhibit a partially different type». In der Analyse der Rassenzusammensetzung der schwedischen Bevölkerung, die die Arbeit abschliesst, kommen die Autoren zu dem Schluss, dass (S. 155) »the purer East Baltic type includes 8.68 % of all Swedish born examinees». Er ist besonders allgemein einerseits in den nördlichen Teilen des Reichs (Norrbotten 15.04 %, Västerbotten 12.03 %), wo die Bevölkerung grossenteils aus Finnen besteht, andererseits in den südlichsten Teilen (Blekinge Län 13.80 %, Kristiansstads Län 11.99 %, Kalmar Län 10.11 % u. s. w.), kommt aber auch übrigens im ganzen Lande vor.

Nach den von dem Dänischen antropologischen Ausschuss über die anthropologischen Verhältnisse Dänemarks[2]) veröffentlichten Untersuchungen zu urteilen, ist der betreffende Typus auch in diesem Lande stark vertreten. Mehr als wahrscheinlich ist auch, dass er in Deutschland vorkommt, obwohl direkte Untersuchungen über das Auftreten des Typus, meines Wissens, dort nicht vorliegen. GÜNTHER[3]), der sich jedoch ausschliesslich an okuläre Beobachtungen zu halten hat, sagt indessen (S. III): »Im deutschen Osten sieht man diese Rasse, im übrigen Deutschland fällt sie dem Betrachter nicht in die Augen». HAUSER[4]), der den Typus zwar nicht als eine besondere Rasse auffasst, worauf ich späterhin zurückkommen werde, geht so weit, dass er sagt (S. 165): »die Ostischen scheinen die eigentlich 'deutsche Rasse' werden zu wollen», was aber sicherlich sehr übertrieben ist. Schliesslich möchte ich noch erwähnen, dass ein ähnlicher Typus auch in Holland und in der Schweiz nachgewiesen worden ist. In einer anthropologischen Untersuchung über die Bevölkerung Nordhollands und Frieslands stellt Bolk[1]) fest, dass die Bevölkerung aus zwei verschiedenen Typen besteht, von denen der eine hochgewachsen, blond und langköpfig, der andere dagegen kürzer, blond und kurzschädlig ist. In der Schweiz wieder hat Schlaginhaufen[2]) bei kritischer Untersuchung der Merkmalskombinationen schweizerischer Rekruten konstatiert, dass hellfarbige Brachycephalen im Lande ziemlich häufig vorkommen.

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[1]) H. LUNDBORG and F. J. LINDERS: The Racial Characters of the Swedish Nation. Anthropologia Suecica MCMXXVI. Uppsala 1926.

[2]) Meddeleiser om Danmarks antropologi. I, 1907—11, II, 1920—27.

[3]) HANS K. F. GÜNTHER: Rassenkunde des deutschen Volkes. 6 Aufl. München 1924.

[4]) O. HAUSER: Rassebilder. Braunschweig und Hamburg 1925.

Man fragt sich nun, ist dieser weit verbreitete blonde brachycephale Typus, der unter vielen verschiedenen Namen von so zahlreichen Autoren mit im grossen und ganzen sehr gut übereinstimmenden Definitionen beschrieben worden ist, ist er eine selbständige Sonderrasse — insoweit man überhaupt von wohlbegrenzten Rassen sprechen kann! — oder ist er lediglich als ein Kreuzungsprodukt anzusprechen?

Auf Grund der mir zu Gebote stehenden Literatur dürfte man die Behauptung wagen können, dass die Mehrzahl der anthropologischen Forscher die erstgenannte Alternative vertreten. Aber auch andere Auffassungen sind von sehr sachverständiger Seite geltend gemacht worden. Ich nenne zunächst den namhaften deutschen Anthropologen Fischer. In seiner ausserordentlich interessanten, an glänzenden Kombinationen und Gesichtspunkten reichen Übersicht über die Rassenverhältnisse in der Welt, die in dem Werk »Anthropologie»[3]) enthalten ist, wie auch in der gedrängten Darstellung in dem Baur-Fischer-Lenzschen Sammelwerk[4]) hat Fischer dem betreffenden Typus seine Daseinsberechtigung als Rasse abgesprochen. In der erstgenannten Arbeit sagt er (S. 152): »Ausser diesen Rassen (d. h. den vier Grundrassen Europas) nehmen einzelne Autoren noch einige weitere als feststellbare Sonderrassen an, so eine »Ostrasse», die blond, subbrachycephal und klein sein soll — — — es sind stets mittlere, gemässigte, sozusagen abgeschwächte Merkmale, die diesen zukommen, die sich alle leicht durch Mischung erklären lassen, auch wenn in einzelnen Fällen unmöglich gesagt werden kann, warum gerade an der Stelle eben diese Mischung relativ stark vertreten sein soll».

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[1]) L. Bolk: Repartition du type blond et du type brun dans les Pays-Bas. Bull. et Mem. Soc. d'Anthropologie, T. 5, Paris 1904.

[2]) O. Schlaginhaufen: Körpergrösse, Kopfform und Farbmerkmale von 250 schweizerischen Rekruten. Bulletin der Schweiz. Gesellschaft f. Anthrop. u. Ethnol. 1926—1927, Bern 1927.

[3]) E. Fischer: Spezielle Anthropologie. Im Werke: G. Schwalbe und E. Fischer, Anthropologie. Leipzig und Berlin 1923.

[4]) E. Fischer: Rassenbeschreibung (Anthropographie). Im Werke: Baur-Fischer-Lenz, Menschliche Erblichkeitslehre und Rassenhygiene, I. Band. 1. Aufl. 1921, 3. Aufl. München 1927.

Und in dem letzterwähnten Werk (3 Aufl. S. 154) heisst es: »Ob wirklich, wie CZEKANOWSKI und seine Schule durch den Nachweis von gehäufter Korrelation von Blondheit und Brachycephalie in Polen dartun wollen, und wie jetzt auch GÜNTHER annimmt, in Polen und dem Ostbaltikum eine weisse Rasse sich gebildet hat, die GÜNTHER u. a. als 'ostbaltische' bezeichnet, ist zweifelhaft. Die Kombination jener Merkmale könnte auch rein durch Kreuzung entstanden sein». FISCHER hält dafür, wie auch aus einer beigefügten Karte (BAUR-FISCHER-LENZ, S. 148) hervorgeht, dass die blonden Brachycephalen durch Kreuzung der Mongoliden und der nordischen Rasse entstanden sind. Dieselbe Auffassung vertritt auch HAUSER[1]), der unter anderem schreibt (S. 165): »Dass man die Ostischen noch weniger als die Dinarischen eine Rasse nennen darf, ersieht man vor allem daraus, dass bei ihnen die blauen Mongolenflecke der Neugeborenen überaus häufig (?) sind, bei Slaven wie Deutschen. Andere Merkmale kommen hinzu. Die Ostischen sind erst recht eine gewordene Gruppe, und sie entstehen immer aufs neue, wo Nordlinge die widernatürliche Verbindung mit dunkleren Mongoloiden eingehen» (!). Eine ganz ähnliche Auffassung finden wir noch in der vierten Auflage von GÜNTHERS bekannter Arbeit[2]). Bei Besprechnung der Finnen nennt er dieselben »ursprünglich ein mongolisches (innerasiatisches) Volkstum», das sich mit nordischen Rassenelementen gemischt hat. In der sechsten Auflage hat aber diese Auffassung eine durchgreifende Änderung erfahren. Jetzt ist nicht mehr von einem Kreuzungsprodukt zwischen Mongoliden und Nordlingen die Rede, sondern von einer selbständigen hellfarbigen, kurzköpfigen, breitgesichtigen Rasse, die nach NORDENSTRENG und auf seine Anregung hin die ostbaltische Rasse genannt wird.

Ferner muss in diesem Zusammenhang der norwegische Anthropologe BRYN erwähnt werden, der als ein ausserordentlich produktiver Erforscher der Anthropologie Norwegens bekannt ist. Auch er kann der Ansicht, dass die blonden Brachycephalen eine Sonderrasse ausmachen sollten, nicht beitreten. In einer neulich herausgegebenen zusammenfassenden Übersicht über die anthropologischen Verhältnisse des Landes[3]), behandelt BRYN die Frage von den norwegischen blonden Brachycephalen, auf die, wie oben erwähnt, ARBO und HANSEN die Aufmerksamkeit gelenkt hatten. Nachdem er hervorgehoben hat, dass (S. 180) die blonden Brachycephalen an die Gegenden des Landes geknüpft sind, in denen es die meisten dunkelhaarigen Individuen gibt, und weiter, dass ein ausgeprägtes Korrelationsverhältnis zwischen der Brachycephalie und der Euryprosopie, zwischen der Mesocephalie und den blauen Augen und zwischen der Brachycephalie und den pigmentierten Augen besteht, äussert er sich über das blonde brachycephale Element in Norwegen folgendermassen (S. 182): »In allen wesentlichen Hinsichten stimmt dieser norwegische brachycephale Typus überein mit dem mitteleuropäischen brachycephalen Typus, den wir jetzt die alpine Rasse nennen. Ihre Blondheit hat sie durch die intensive Kreuzung mit einer ihr an Zahl überlegenen nordischen Bevölkerung erhalten. Irgend ein blonder brachycephaler Typus, bei dem die Blondheit genetisch an die Brachycephalie gebunden ist, ist nie in Norwegen nachgewiesen worden. Die blonden Brachycephalen sind immer nur Bastarde».

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[1]) O. HAUSER: 1925, l. c.

[2]) HANS K. F. GÜNTHER: l. c. 4. Aufl. München 1923.

[3]) H. BRYN: Die Menschenvarietäten Norwegens. Anthrop. Anzeiger III, 1926.

In der erwähnten Abhandlung hat Bryn, wie ersichtlich, lediglich die Verhältnisse in Norwegen beachtet. In einer anderen, etwas früher von ihm in norwegischer Sprache veröffentlichten Arbeit, einer allgemeinen Rassenkunde[1]), hat er indessen auch die Finnen berücksichtigt, wobei dieselben Gesichtspunkte angeführt werden. Eine besondere ostbaltische Rasse existiert nach Bryn nicht — »es liegen noch keine (?) von Anthropologen anerkannten Beweise für das Vorkommen anderer Rassenelemente in Finnland vor, als der nordischen Rasse, der alpinen Rasse und der samischen (lappländischen) Rasse» (S. 179). Und weiter heisst es (S. 181): »Die finnisch-ugrische Rasse (?) dürfte eine Mischrasse sein, deren Hauptbestandteile nordische Rassenelemente ausmachen, die teils mit samischen, teils mit alpinen Rassenelementen sich gekreuzt haben. Die Theorie von zwei blonden Rassen, einer nordischen und einer finnischen, kann einer eingehenden Kritik kaum standhalten». (Es verdient in diesem Zusammenhang erwähnt zu werden, dass Bryn von der von den meisten Anthropologen vertretenen Theorie scharf Abstand nimmt, dass die Lappen rassisch zu den Mongolen zu zählen seien. Sie bilden, seiner Ansicht nach, eine selbständige »samische Rasse», die in anthropologischer Hinsicht mit den Mongolen nichts gemein hat).

Eine ungefähr änhliche Auffassung von den blonden Brachycephalen wie Bryn hat auch Haddon[2]), der in ihnen (S. 27) eine spezielle Variante der alpokarpatischen (alpinen) Rasse — »a fair-haired variety with lower brachycephaly (c. i. 82—83), broad square face, nose often concave, and blue or grey eyes» — sieht. Die Blondheit erklärt er auf folgende Weise: »a local bleaching may have taken place, but Nordic mixture is indicated».

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[1]) H. Bryn: Menneskerasene og deres udviklingshistorie. Oslo 1925.

[2]) A. C. Haddon: The Races of Man and their Distribution. New Edition. Cambridge 1924.

Schliesslich ist in diesem Zusammenhang eine denkwürdige Studie von v. EICKSTEDT[1]) zu nennen. Er führt die Osteuropäiden, mit welchem Namen er DENIKERS »race orientale» und NORDENSTRENGS »ostbaltische Rasse» nennt, zu den »Zwischenformen», also morphologischen Zwischengliedern, ohne aber damit betonen zu wollen, dass sie ein Resultat der Mischung wären. Er hebt ausdrücklich (S. 246) die Einheitlichkeit des heutigen osteuropäiden Typus hervor, sagt aber: »vielleicht war Mischung bei ihrer Entstehung im Spiel, in alter, nur geologisch zu messender Zeit.»

Man fragt sich nun: kann man irgendwelche gewichtige Gründe dafür anführen, dass der weitverbreitete blonde brachycephale Typus ein Mischprodukt sei? Und vor allem: ist es möglich darzulegen, dass die nordische Rasse in dem blonden brachycephalen Typus als ein wesentlicher Rassenkomponent enthalten wäre? Ich kann nicht finden, dass es sich so verhalten sollte. Man muss sich zuerst vergegenwärtigen, dass der blonde, kurzköpfige, breitgesichtige Typus ausserordentlich gemein ist, und sogar in ausgedehnten Gebieten, besonders in Osteuropa vorherrscht, wo die blonde nordische Rasse garnicht oder in verschwindend geringer Anzahl vertreten ist. Und wenn man in Betracht zieht, dass die hellen Farben in vererbungswissenschaftlicher Hinsicht rezessiv sind, hätte ja das nordische Element ganz ausserordentlich zahlreich sein müssen, um einem Kreuzungsprodukt die blonden Farben geben zu können. Hierzu kommt als wichtiger Umstand, dass die Blondheit bei den blonden Brachycephalen, nach allem zu urteilen, etwas ganz anderes ist als das, was bei den Nordischen vorkommt. Mehrere Forscher haben schon darauf hingewiesen. NORDENSTRENG[2]) schreibt (S. 117), dass »das Haar bei den Ostbalten graublond in verschiedenen Tönen bis zu flachsweiss ist. Dagegen dürfte ein etwas ins rötliche spielender Ton kaum der ostbaltischen Rasse eigen sein, sondern wo dieser vorhanden ist, muss er wohl seinem Ursprung nach als nordisch betrachtet werden» — eine Auffassung, die ich auf Grund persönlicher Beobachtungen vollkommen teile. HAUSER[3]) bemerkt (S. 163): »die Blondheit dieser Ostischen ist völlig anderer Art als die der Nordischen. Auch sie beruht auf Farbstoffmangel, aber der Farbstoff ist ein anderer und darum der Ton der Haare auch bei grösster Lichtheit deutlich von dem der nordischen zu unterscheiden . . .». Aus ähnlichen Gründen nimmt auch Hella Pöch[1]) entschieden Abstand von der Auffassung über die Blondheit der »hellen Ostrasse» als Folge nordischen Einflusses, indem sie hervorhebt, dass das Blond der hellen Ostrasse idiotypisch vom Blond der nordischen Rasse verschieden ist. »Meine aus einer Beobachtung der Vererbung der Haarfarbe[2]) abgeleitete Ansicht, dass das Blond der Ostrasse ein vom nordischen durch eine andere Faktorenzusammensetzung abweichendes Blond ist, scheint kürzlich ihre Bestätigung in den Arbeiten von Bounak[3]) und Sobolewa[4]) gefunden zu haben» (S. 35). Dasselbe dürfte auch von der Irisfarbe gesagt werden können — auch hier können Verschiedenheiten zwischen der nordischen Rasse und den blonden Brachycephalen nachgewiesen werden (Pöch, Nordenstreng u. a.). Und schliesslich gilt dies auch von der Hautfarbe. Sie ist zwar bei den Ostbalten entschieden hell — nicht gelbbraun, wie einige Autoren sagen — sie hat aber nicht die für die Nordischen charakteristische durchsichtige, zarte rosige Weisse, sondern einen mehr graulichen Ton. Dies alles spricht wohl ganz entschieden gegen das Herstammen der hellen Komplexion der Ostbalten von der nordischen Rasse. Und schliesslich: wenn die »Ostbalten» ein Kreuzungsprodukt wären mit der nordischen Rasse als integrierendes Element, erscheint es unbegreiflich, dass die nordische Rasse keine anderen somatischen (und wohl auch keine psychischen) Charakterzüge bei den Mischlingen hinterlassen hätte. Denn in so gut wie allen Hinsichten unterscheiden sich die beiden Typen stark von einander. Ich kann also durchaus keine triftigen Gründe finden, die für die Beteiligung der nordischen Rasse an der Entstehung des blonden brachycephalen Typus sprechen sollten. Und da die nordische Rasse[5]) die einzige ist, die a priori bei der Entstehung der hellen Komplexion in Betracht kommen könnte, falls die blonden Brachycephalen ein Mischprodukt wären, muss man also annehmen, dass die Blondheit eine ursprüngliche charakteristische Eigenschaft der »Ostbalten» ist.

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[1]) E. VON EICKSTEDT: Gedanken über Entwicklung und Gliederung der Menschheit. Mitt. d. Anthrop. Ges. in Wien, Bd. LV, 1925.

[2]) R. NORDENSTRENG: 1926. l. c.

[3]) O. HAUSER: 1925, l. c.

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[1]) Hella Pöch: 1926, l. c.

[2]) Hella Pöch teilt mit, dass eine Abhandlung über die Vererbung der Haarfarbe bei den wolhynischen Ukrainern demnächst erscheinen werde.

[3]) V. V. Bunak: Ein Versuch der Bestimmung des Fenotypus der Haarfarbe mittels der Spectro-Photometrie (russisch, deutsche Zusammenfassung). Bull. de la Soc. Nat. Moscou, Sect. Biol. expér. 1, 1925.

[4]) G. W. Sobolewa: Spektrophotometrische Untersuchungen der Farbe menschlicher Haare (russisch, deutsche Zusammenfassung). Bull. de la Soc. Nat. Moscou, Sect. Biol. expér. 1, 1925.

[5]) Anmerkung. Als diese Studie schon geschrieben war, erhielt ich von Dr. K. Saller eine ganz neulich erschienene grosse Abhandlung über die nordische Rasse. Nach Sallers Meinung ist der moderne Begriff der »nordischen Rasse» nicht haltbar. »Mit der heute angenommenen nordischen Rasse handelt es sich um eine Konstruktion, die aus der Kombination einzelner extremer und deshalb leicht zu beachtender Merkmale gebildet wurde, aber im Tatsachenmaterial keine entsprechende Grundlage hat. Man vernachlässigt bei solchen Typus-Aufstellungen die Mittelgruppe, die zwischen den einzelnen extremen

Durch ihre durchgehend helle Komplexion unterscheiden sich die blonden Brachycephalen entschieden von den Mongoliden, die, wie oben hervorgehoben, von einigen Autoren als die Stammverwandten der »Ostbalten» angesehen werden. Wiewohl die »Mongolen» ja keine gut ausgeprägte, scharf abgegrenzte Rasse bilden, sondern in eine grosse Menge von sekundären Einzelrassen zerfallen, sind die hellen Komplexionsmerkmale diesen allen entschieden fremd. Und übrigens ist bereits der allgemeine Eindruck, den man einerseits von typischen Mongoliden, andererseits von den Ostbalten erhält, ein ganz verschiedener. Dies wage ich schon auf der Basis von Beobachtungen, die ich teils in Zentralasien, teils in Finnland gemacht habe, zu behaupten. Und dasselbe hat ja u. a. auch BUNAK ausdrücklich betont. Das für die Mongolen so charakteristische ausserordentlich flache Gesicht mit den sehr stark betonten Backenknochen und mit den geschlitzten, schief nach aufwärts gerichteten Lidspalten, die durch die Mongolenfalte bedingt sind, sieht man nur in seltenen Ausnahmefällen in Gegenden, wo der ostbaltische Typus vorherrschend ist, wie z. B. in Finnland. Und, wie ich bereits früher erwähnt habe, fehlt auch der für die Mongoliden typische Mongolenfleck. Ich gebe andererseits gern zu, dass man gewisse Übereinstimmungen zwischen den Mongolen und den Ostbalten nachweisen kann, dass man aber deshalb die Ostbalten ganz einfach zu den Mongoliden zählen dürfte, kann ich nicht für richtig halten. Es ist ja auch nicht schwer, zwischen anderen gut von einander abweichenden Rassen gewisse Ähnlichkeiten nachzuweisen.

Ebensowening wie ich es für angebracht finden kann, die Ostbalten für Mongoliden anzusehen, die ihre charakteristische Blondheit durch Mischung mit der hellen nordischen Rasse erhalten hätten, kann ich der Ansicht BRYNS beitreten, der die blonden Brachycephalen als »Alpine» anspricht, die »ihre Blondheit durch intensive Kreuzung mit einer ihr an Zahl überlegenen nordischen Bevölkerung» erhalten haben. Dies lässt sich keinesfalls auf die blonden Brachycephalen im allgemeinen anwenden, sowohl auf Grund der Verschiedenheit der Blondheit und weil »eine an Zahl überlegene nordische Bevölkerung» in den grössten Teilen des Verbreitungsgebiets des Typus nicht vorge-

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Typen liegt» (S. 587). Ich habe hier nicht die Möglichkeit auf diese Frage einzugehen. Siehe:

K. SALLER: Die Entstehung der »nordischen Rasse». Zeitschrift für Anatomie und Entwicklungsgeschichte, Bd. 83, H. 4, 1927.

kommen ist. Ausserdem unterscheiden sich aber die Ostbalten und die Alpinen recht stark von einander, wie bereits ARBO hervorhebt. Man kann mit Leichtigheit eine Menge Verschiedenheiten in der Form des Schädels und des Gesichts, in dem Körperbau und der Körpergrösse nachweisen, — der Farbe der Haut, des Haars und der Augen ganz zu geschweigen.

Kurz, ich kann nicht finden, dass die angeführten Gründe gegen die Existenz einer selbständigen blonden, kurzköpfigen und breitgesichtigen Rasse irgendwie schwerwiegend wären. Ich schliesse mich deshalb unbedingt denen an, die mit einer besonderen blonden brachycephalen Rasse in unserem Weltteil rechnen.

Welchen Namen diese erhalten soll, ist eine Frage von sekundärer Bedeutung. Ich habe wie NORDENSTRENG die Benennung »ostbaltische Rasse» angewandt, weil die Rasse vorzugsweise in den Ländern östlich von der Ostsee verbreitet ist. Der vom Österreicher angewandte Name »Ostrasse» oder »helle Ostrasse», sowie DENIKERS »östliche Rasse» ist ja auch ganz beleuchtend, da aber GÜNTHER begonnen hat, die alpine Rasse mit dem wenig zweckmässigen Namen »ostische Rasse» zu bezeichnen, kann eine Verwechslung leicht aufkommen. DENIKERS »race orientale» kann übrigens leicht auch mit FISCHERS »orientalischer Rasse» verwechselt werden, die etwas ganz anderes ist. Es würde ohne Zweifel der Sache zum Vorteil gereichen, wenn die Anthropologen sich um eine gemeinsame Benennung einigen könnten.

Die ostbaltische Rasse ist wie die übrigen Rassen Europas und der ganzen Welt einer starken Mischung ausgesetzt gewesen, und sie kommt kaum irgendwo ganz »rein» vor. In diesem Mischungsprozess haben die Mongoliden — ich möchte dies ausdrücklich betonen — sicherlich eine nicht unwichtige Rolle gespielt. Je länger nach Osten man kommt, desto augenfälliger beginnt anscheinend der mongolische Einfluss sich geltend zu machen. Gerade dieser Umstand mag teilweise die Auffassung von dem mongoliden Ursprung der Rasse erklären, die oben behandelt wurde. In den westlichen Teilen des Verbreitungsgebiets der Rasse, z. B. in Finnland und Skandinavien, ist der mongolide Einschlag dagegen spärlich. Hier macht sich vor allem die nordische Rasse geltend. In allen Küstengegenden um die Ostsee herum kann man deutlich den nordischen Einschlag verfolgen. Denken wir an die Verhältnisse in Finnland, so ist der nordische Einschlag am deutlichsten in den Gegenden, die den Küsten des Bottnischen und Finnischen Meerbusens am nächsten liegen und die von einer schwedisch sprechenden Bevölkerung bewohnt sind, nimmt aber allmählich ab, je mehr man ins Innere des Landes kommt, wohin die schwedische Ansiedelung sich nicht erstreckt hat.

In Finnland, wie auch in Skandinavien, hat sich die ostbaltische Rasse auch einigermassen mit der »samischen Rasse» oder den Lappen gemischt. Sicherlich muss wenigstens teilweise die dunkle Augen- und Haarfarbe, die in der überwiegend blonden Bevölkerung des Landes vorkommt, gerade dem Einfluss seitens der Lappen zugeschrieben werden. Es ist nämlich zu bemerken, dass die Lappen früher über ein viel weiteres Gebiet verbreitet gewesen sind als heute, wo nur die Fjeldgegenden im hohen Norden ihre Wohnplätze ausmachen. Die Ortsnamenforschung hat dargelegt, dass die Lappen vorzeiten über fast ganz Finnland verbreitet gewesen sind, und noch im 14:ten bis zum 16:ten Jahrhundert werden in historischen Urkunden verstreute lappländische Familien im mittleren Finnland erwähnt. Es ist deshalb offenbar, dass schon sehr früh eine gewisse Mischung zwischen den beiden Rassen — der ostbaltischen und der samischen — stattgefunden hat, und diese Mischung hat bis in unsere Zeit hinein in den nördlichen Teilen des Landes in kleinerem Masstabe fortgesetzt.¹)

Auf Grund des weit ausgedehnten Gebiets der ostbaltischen Rasse ist es ganz natürlich, dass mehrere andere Rassen — südlich von der Ostsee wahrscheinlich im hohen Grade die alpine Rasse — fremde Erbanlagen in die ostbaltische Rasse eingeführt und zur Entstehung verschiedener Neukombination beigetragen haben. Europa ist ja schon auf Grund seiner Bodengestaltung, die keine unübersteigbaren Hindernisse aufzuweisen hat, zum Tummelplatz verschiedener Rassen und Völker sozusagen vorausbestimmt gewesen. Und zumal das östliche Europa, also das Kerngebiet der ostbaltischen Rasse, ist auf Grund seiner Lage, seiner weiten Ebenen und seiner ruhig fliessenden Ströme Volkswanderung verschiedener Art ausgesetzt gewesen.

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Ich habe versucht, ein Bild der ostbaltischen Rasse und ihres Verbreitungsgebiets zu zeichnen, soweit dieses innerhalb des engen Rahmens eines Vortrags möglich gewesen ist. Irgendwelche ganz neuen Gesichtspunkte habe ich kaum hervorheben können noch wollen. Es war lediglich meine Absicht, eine kurzgefasste Zusammenstellung dessen, was wir gegenwärtig über diese Rasse wissen, zu geben. Ich bin mich natürlich vollkommen dessen bewusst

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¹) Ob die im östlichen Finnland, in Karelen, verhältnismässig zahlreich vorkommenden dunklen Typen, die auch sonst von dem »tavastländschen» Typus abweichen, auf lappländische Beimischung zurückzuführen sind, oder aber ob die Karelier ihrem Kern nach einer anderen Rasse angehören (NORDENSTRENGS »Ontrus-Rasse»?) als die Tavasten, ist eine Frage, auf welche hier nicht eingegangen werden kann.

dass ich bei weitem nicht die vorliegende Frage habe lösen können. Auf Grund des oben angeführten scheint es mir jedoch ziemlich sicher zu sein — ich möchte es nochmals hervorheben —, dass wir in unserem Weltteil nicht nur eine, sondern zwei blonde Rassen haben, die sich sonst in vielen Hinsichten von einander unterscheiden. Es dürfte deshalb nicht richtig sein — wie man es oft getan hat — überall da, wo man helle Komplexionsmerkmale im Volkstum nachweist, auf den Einfluss der nordischen Rasse zu schliessen. Abgesehen von denjenigen Fällen von Blondheit, Helläugigkeit und Hellhäutigkeit, die nach FISCHER¹) als Domestikationserscheinungen an allen möglichen Stellen in der Menschheit spontan auftreten können, ist es mehr als wahrscheinlich, dass diese Merkmale sehr oft der ostbaltischen Rasse entstammen.

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¹) E. FISCHER: Die Rassenmerkmale des Menschen als Domestikationserscheinungen. Zeitschr. f. Morph. u. Anthrop. Bd. 18, 1914.

E. FISCHER: Rasse und Rassenentstehung beim Menschen. Berlin 1927.

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ACTA GEOGRAPHICA

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1. **H. Hausen:** The Upper Yenissei Drainage Area (Territory of Uriankhai). GENERALITIES. — GEOLOGICAL OBSERVATIONS MADE DURING AN EXPEDITION IN 1917 by *J. J. SEDERHOLM* (Chief of the Expedition), *H. G BACKLUND* (practical leader), *ST. FOSLIE, TH. BRENNER* and *THE EDITOR*. — FURTHER OBSERVATIONS DURING 1918 by *THE EDITOR*. — BIBLIOGRAPHY. — ITINERARY MAPS made by *ST. FOSLIE* and *H. G. BACKLUND* partly in Company with *THE EDITOR* .... 1—186
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